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THE

CYCLOPEDIA

OF

PRACTICAL SURGERY;

INCLUDING

AN ETYMOLOGICAL AND CRITICAL TERMINOLOGY;

DETAILED DESCRIPTIONS OF INSTRUMENTS AND APPARATUS;

A COPIOUS BIBLIOGRAPHY;

AND AN

HISTORICAL VIEW OF THE PROGRESS OF THE SCIENCE TO THE PRESENT DAY:

THE WHOLE PRESENTING

A COMPLETE DIGEST

ALPHABETICALLY DISTRIBUTED, OF

THE DOCTRINES AND PRACTICE OF SURGERY.

CONDUCTED BY
WILLIAM B. COSTELLO,
ASSISTED BY
NUMEROUS DISTINGUISHED WRITERS,
IN THE VARIOUS DEPARTMENTS OF MEDICAL AND SURGICAL SCIENCE.

ILLUSTRATED WITH NUMEROUS ENGRAVINGS AND WOOD-CUTS.

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THE

CYCLOPÆDIA

OF

PRACTICAL SURGERY.

ABAPTISTA from *α*, privative, and *βαπτίζειν*, to plunge (obsolete). A name used to designate the terebra, or conical-shaped circular saw of the ancient surgeons. Their object in employing an instrument of that shape was to prevent, as the name expresses, its penetrating beyond the bones of the cranium, into the dura mater and brain. (For a better means of obviating this accident, see TREPHINE.)

ABDOMEN, *venter*, *alvus*. Lat. *ὑπογάστριον*, *γαστὴρ*, Gr. *ventre*, *bas ventre*, Fr. *Unterleib*, *Bauch*, *Schmerbauch*, Ger. *ventre*, *pancia*, *abdomine*, Ital. *vientre*, *barriga*, *panga*. Span. *belly*, Eng. The *abdomen*, in Human Anatomy, is the largest of the three visceral cavities; and is situated between the thorax and lower extremities: it derives its appellation from the Latin word *abdere*, in consequence of its concealing, as it were, its contents. The term applies to the containing and contained parts; to the walls, and to the organs they enclose. The word cavity is a mere abstraction; in the integral state of a living man there is no cavity, the entire space being occupied by some of the principal organs of digestion, assimilation, secretion, generation, excretion, &c. After premising a few general remarks, we shall therefore consider successively the walls and the cavity of the abdomen.

The abdomen is situated before the lumbar portion of the vertebral column; above the pelvis, which may be considered as an appendage; and below the thorax, from which it is separated by the diaphragm, in man and mammalia. Its superior boundaries are not well marked exteriorly; within, it is defined by the diaphragm, a moveable septum, which alternately enlarges and contracts the two cavities, at the expense of each; hence a source of many errors in diagnosis, which are much more frequent than is generally believed.

General considerations. In the development of the human germ, the abdomen is the first part formed; it is, so to speak, the *radicle* of the future being: this is so strictly the fact, that the fœtus, however imperfect or irregular its formation may otherwise be, is always normal in the respect of possessing this portion of the organism. The abdomen, therefore, whether as regards man or the lower grades of animals, is the point from which the creature springs, and around which, according to his grade in the scale of beings, the other organs are grouped in succession; the abdomen and its contents are the primitive elements, the organs of first formation.

In comparing, on the skeleton, the abdominal with the cranial and thoracic cavities, we observe a very striking difference in the bony formation of each.

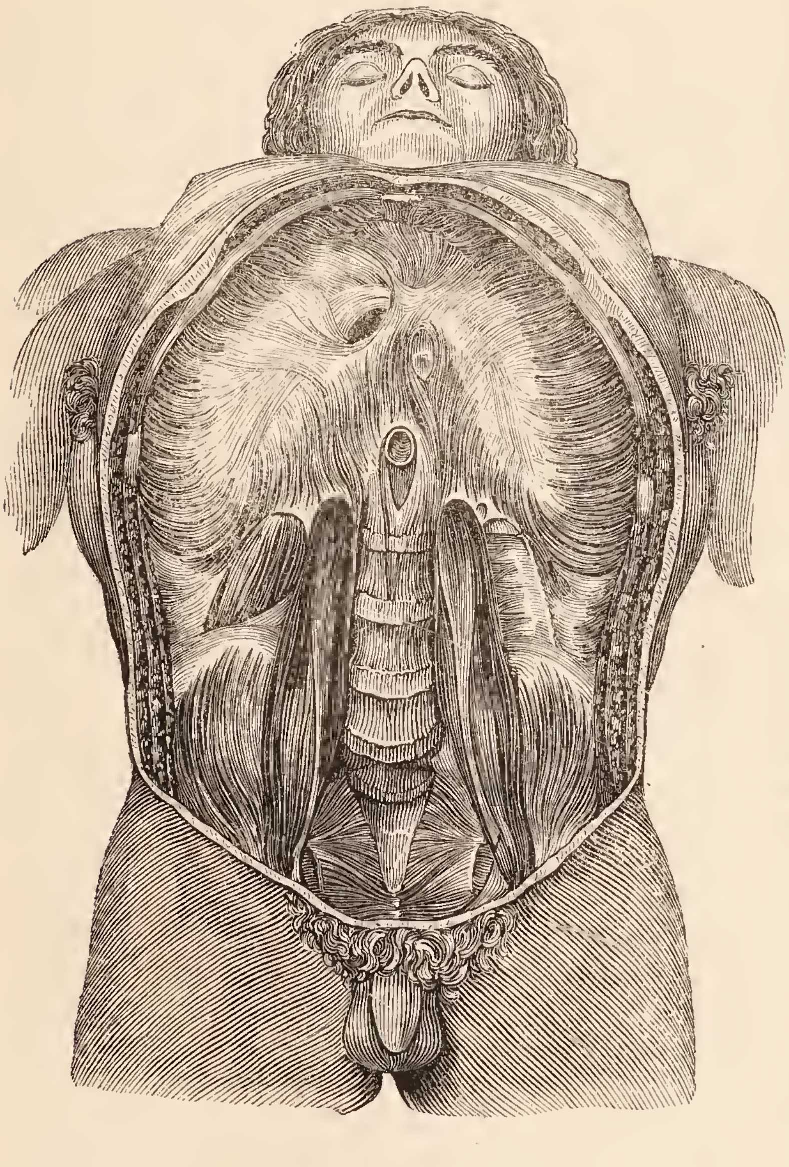
In the cranium, the most perfect physical protection is secured for its contents by their complete envelopment in bones of a certain hardness, formed and joined together in a peculiar manner.

In the thorax, bones form a very large portion of its limits, and afford ample protection to the contained organs; but as total immobility would here be incompatible with the due performance of the functions of these organs, the interosseous spaces are filled up, and the cavity completed by the muscles necessary to the act of respiration.

In the construction of the abdomen, we observe a complete contrast with that of the skull: in the latter, motion would be incompatible with function; in the former it is, to a great extent, indispensable. The thorax, as regards mobility, is the mean between these two extremes. The soft parts of the abdomen, therefore, predominate considerably over the osseous. Of the soft parts themselves, some enjoy great extent of motion, while others are as firmly fixed as the bones to which they adhere.

Parietes of the Abdomen.—As regards the parietes, therefore, and abstractedly from the nature of the parts that compose them, they may be considered as the *moveable* or floating, and the *motionless*. The *moveable* external walls, if detached all around from the edges of the bony frame, upon which they are spread out and supported, and if they are extended upon a plane surface, will represent the figure of a Maltese cross, the perpendicular limb, corresponding to the *linea alba*, from the xiphoid cartilage to the pubis ; the transverse, to a line curved in proportion to the size of the abdomen, drawn from the transverse processes of the lumbar vertebræ, on one side, to the same points on the other. The floating external wall being thus detached, the frame of the abdomen will represent a deep architectural niche, vaulted above by the diaphragm, (the remaining portion of the moveable walls) and excavated below, to form the well or pelvis ; the direction of the niche is somewhat oblique, being bent back at both ends.

Fig. 1.



The cavity of the abdomen, the anterior moveable walls, and viscera removed.

The frame itself is extremely solid, and contributes mainly to the sustainment and proper position of the organs which it shelters ; without this disposition, the erect posture would be impossible, and the viscera would crush each other. A space of unvarying dimensions being thus provided, the abdominal cavity is completed by parietes consisting entirely of soft parts. The unyielding protection of bone is now sacrificed to the necessities of function ; mobility and protection must be combined in the texture of the parietes ; in a word, the ever-varying bulk of the contained viscera requires extensibility in the walls to meet the condition of distension ; elasticity to restrain its excess, and to spring back in proportion as the distension diminishes ; and contractility to assist in the due performance of the functions of those organs. The structures endowed with these properties, are muscles, fasciæ, tendinous expansions, cellular tissue, &c. of which the moveable walls of the abdomen are exclusively formed.

It is not our purpose in this article to enter into a detailed description of each of these parts. These details are minutely and lucidly exposed in a more appropriate place,—*the Cyclopædia of Anatomy and Physiology, Art. Abdomen*, to which we beg to refer the reader. Our chief object being to give a rapid sketch of the surgical questions connected with this region, we shall enter no further into its anatomy than will be necessary to illustrate the various points under consideration,—to guide diagnosis,—or to form a ground-work for surgical precepts.

Osseous Parietes.—These are formed above, anteriorly by the ensiform cartilage of the sternum ; laterally by the lower ribs ; posteriorly by the lumbar vertebræ, sacrum, and coccyx ; and inferiorly by the ilia. Although, we refrain purposely from minute osteological details, it yet appears proper to point out the leading distinctive characters between the bones of the pelvis, and the ribs and sternum, with regard to the kind and degree of motion they derive from the action of the muscles. The latter, under the influence of muscular action are so moved, as to alter directly the position of the subjacent viscera ; so that we must here consider the bony walls of the abdomen as actively engaged in modifying the dimensions of the ventral cavity ; while the bony walls of the pelvis, on the contrary, remain during the action of the abdominal muscles unmoved, offering at the same time, however, a firm point of resistance, and thus permitting, through the medium of muscular contraction, pressure on the pelvic organs, and facilitating the propulsion of their contents. The internal surfaces of these bony walls are chiefly padded with muscles ; for the description of which we must refer the reader to the elementary works on Anatomy, and pass on to the consideration of the floating walls themselves.

Soft Parietes of the Abdomen.—These are formed for the most part of the flat or broad muscles, which derive their names from their position, form, or the direction of their fibres ; they consist of five pairs placed symmetrically with regard to the median line.

Viewed externally the abdomen represents an oval, convex in front, its long axis being vertical, broader below than above, particularly in females, from the naturally greater expansion of the pelvis after puberty in that sex ; the reverse of this obtains in the fœtus. Owing to the alternating contraction and dilatation of the walls of the thorax and diaphragm, the convexity of its outline varies incessantly during life ; in emaciated subjects it is not convex but flat, particularly after death.

The combination of muscle and aponeurosis in the composition of the moving walls of the abdomen is highly important; they are distributed according to the relative necessities of contractility and resistance. Thus we observe where the former is required, muscle is the principal constituent; where, on the other hand, contractility may be dispensed with, as in the case where provision must be made for the transmission of vessels, &c. the powers of resistance are duly provided for, by means of strong tendinous expansions. Wherever great resistance is necessary, and such is the case, at the points where the pressure of the muscular walls upon the viscera, from the direction of the axes of the abdominal cavity, is more particularly directed, recourse is had to this organic element for protection. Some difference in the distribution of aponeurosis is observable in man, and in large quadrupeds; in the latter it abounds at the thoracic extremity of the abdominal cavity, in the former, at the inferior or pubic portion; an argument, if such were necessary, of his destination for the erect posture. These aponeuroses form perfect sheets, except at the points where arched apertures of various sizes are left for the transmission of vessels, or for the commencement of canals, which are often occupied, in addition to the parts thus transmitted by cellular tissue, and pellets of adipose substance.

The whole extent of the moveable walls may be traced from the bottom of the sternum, along the margins of the inferior ribs, the transverse processes of the lumbar vertebræ, the ridge of the ilium, and stretching across like an arch, from the anterior superior spinous process of this bone to the angle of the pubis: it presents above a small depression, *scrobiculus cordis*, in which the xiphoid cartilage may be felt; this body, constituting as it were a link between the sternum and linea alba, is cartilaginous, flexible, and elastic, more or less depressed in different subjects. About the middle is found the umbilicus, a species of cicatrix, the vestige of the opening which served to transmit the umbilical vessels. Below, the abdomen terminates at the pubis; laterally from this point, towards the ilium, it forms in connexion with the upper part of the thigh, the fold of the groin. The whole is divided into regions, which though arbitrary are useful alike for description and diagnosis, and which shall be noticed hereafter. The upper and lower portions of this moveable wall are narrowed by the convergence of the ribs towards the sternum above, and of the ilia towards the pubis below; in the middle it passes round on each side to the transverse processes of the lumbar vertebræ, and in consequence of the absence of bone throughout this extensive region, it is naturally disposed to yield the most to any distending force.

Before we enter upon the description of the muscles of the abdomen, it will be better, in order to understand their attachments, first to describe the aponeurotic expansion on the anterior part of the abdomen, and which is in fact produced by the tendons of these muscles. When the skin and superficial fascia have been removed from the fore part of the abdomen, an expanded surface of fascia presents itself, reaching from the sternum to the pubes, *above* occupying the space between the two external abdominal muscles, and *below*, that between the two ilia, the pubes dividing this lower margin of the abdominal tendon into two distinct free oblique edges, which are termed Poupart's ligament. On a closer contemplation of this general tendinous expansion, three particular opaque lines arrest the attention; a central one passing in the long axis of the abdomen from the sternum to the pubes, called the *linea alba*, and two lateral lines named the *lineæ semilunares*, which sweep in the form of a crescent from the junction of the cartilage of the eighth with the seventh ribs, to the spinous processes of the pubes. The greater opacity of these lines, as compared with the rest of the fasciæ, is caused by the conjunction and interlacement of the tendons of the three flat pairs of the abdominal muscles.

Abdominal muscles.—Our observations on these shall be brief and general. The most external covers a considerable space anteriorly, and laterally, extending from the lower and lateral part of the thorax down to the crista of the ilium, and from the spine of this bone to the pubis: from the ribs to the ilium its posterior edge is free; its fibres run in various directions towards the *linea alba*; it joins the tendon of the muscle just beneath it at the *linea semilunaris;* the edge extending from the ilium to the pubis is free towards the thigh, and thickened, particularly in its iliac portion, by its continuity with the tendon of the internal muscle; the part of it that is attached to the pubis is divided into two portions or pillars, leaving between them a space in which the spermatic cord in the male, and the round ligament in the female, pass out of the abdomen. Beneath this external layer, a second muscle (*the internal oblique*) is spread, extending from the bottom of the sternum and the cartilages of the ribs to the ilium, cohering with the iliac portion of the lower tendinous border of the preceding muscle; it becomes tendinous at the *linea semilunaris.* Beneath this muscular layer another is concealed; it extends farther behind towards the vertebræ, with which and the ilium it is connected by stronger fasciæ, than either of the two superposed layers; like them, it becomes tendinous at the *linea semilunaris*, and meets its fellow of the opposite side at the *linea alba.*

Before I proceed to describe the straight and pyramidal muscles of the abdomen, it is important to contemplate the direction of the muscles already mentioned collectively, duly to appreciate how perfectly they are adapted to prevent the protrusion of the abdominal viscera, and to produce an equable muscular pressure upon them, during their contraction. It is to be observed how the fibres of the external oblique muscle descend and terminate tendinous below, while the fibres of the internal oblique ascend, and decussating with the fasciculi of the external muscle, terminate tendinous above; and, lastly, how this transverse muscle has its fleshy fibres, so intersecting the decussation of the other two, as completely to close the opening which would otherwise have remained, and have left the viscera constantly exposed to the liability to protrusion. A thin flat muscle (*the rectus*) is extended, ensheathed throughout its entire extent, except for a little way at its lowest part, between the layers of the tendons constituting the *linea alba*, from the pubis to the *scrobiculus cordis;* it is divided transversely by tendinous intersections (*the lineæ transversæ*). The sheath contains another muscle (*the pyramidal*) which also ascends from the pubis, about half-way towards the umbilicus.

The other moveable wall (the diaphragm) is concealed from view, and constitutes the superior boundary of the abdominal cavity; it forms a septum between the abdomen and thorax, ascending deeply even in its quiescent state, into the base of the latter. By this disposition, the upper part of the oval formed by the abdomen as a whole, is spliced, as it were, into the thorax; so that an instrument penetrating horizontally from the back part of the trunk, at any point between the top of the xiphoid cartilage, and the last intercostal space, would pass through the cavities, both of the thorax and abdomen. The action of this muscle is as essential to the function of respiration, as its influence is important upon the abdominal viscera.

The inferior boundary is formed by the pelvis, the excavation of which seems to be an appendix or prolongation of the general cavity. The soft walls in this region possess but little mobility, and consist of the ischio-coccygeal and levatores ani muscles, with an aponeurotic arrangement containing other muscles, &c., proper to the perineum, by which this space is closed.

So far as the osseous, fibrous, and muscular structures serve to form the parietes for the abdomen, they have been noticed; but as allusion has been made to the passage of vessels, nerves, &c., in and out of the cavity, it is obvious that some other tissues are required for the safe occlusion of these outlets, as well as for the purpose of strengthening the parietes generally, and modifying the influence of muscular action upon the abdominal viscera. Accordingly we find entering into the structure of the abdominal walls, cellular tissue, sometimes abounding in small pellets of fat, fascial expansions enveloping the muscles, and a serous membrane, with a free surface, lining the walls and giving a covering to the contained organs throughout almost their entire extent. The fascial expansions are prolonged in the form of more or less perfect sheaths into the outlets, together with cellular tissue and fat: this latter point is peculiarly deserving of notice, as these fatty nodules dilate the openings, when the nutrition is in a high state of activity; thus favouring, if emaciation should suddenly supervene, the protrusion of some portion of the abdominal contents. Under circumstances where these adipose productions have a firm connexion with the cellular surface of the peritoneum, they have been known so to draw upon the serous membrane, by their augmentation of volume, as to form funnels, in which the contained organs have been compressed, and even incarcerated. This has been observed more particularly to occur in the course of the natural outlets; but they have also been known at other points, above the umbilicus, for instance, to produce such distress by making traction on the peritoneum, as to simulate the effects of a strangulation.

The only point of importance, as regards these tumours, is to distinguish them from protrusions of the abdominal contents, and this is, in general, an easy matter, when the tumour is not the seat of pain on pressure, when it is situated near or above the umbilicus, or over the region of the liver, when it has been formed slowly, is irreducible, pediculated, and round. But this is by no means the case, when there are colicky pains in the abdomen, vomiting, and constipation. They vary in size from that of a nut to that of an egg; they are round, smooth, or knobbed, and of the consistence of firm fat, producing neither pain nor inconvenience. Their formation is very simple: a small pellet of adipose substance, adherent to the peritoneum, is pressed out through a slit or natural aperture, until it gets beneath the skin, where it gradually increases in bulk. As it still holds by the peritoneum, it draws upon it, through the narrow opening which had originally given it passage. Instances have been observed, in which the falciform ligament of the liver, and the cord of the umbilical vein had been drawn on in this manner: they also occur in the usual situations of herniæ; when small, and that the opening through which they had reached their superficial situation is large, they may be easily reduced; but when the disproportion between the opening and the tumour is considerable, it is wholly irreducible. These adipose tumours have often betrayed some of the most experienced surgeons into mistakes, and indeed, in many cases, nothing is more difficult, than to avoid confounding them with a strangulated hernia. Pelletan and Scarpa operated in such cases; the latter not discovering his error, until the tumour was exposed: he removed it, and the patient got well. Cruveilhier relates another case that occurred to Dupuytren. In some instances, where an operation had been performed, the issue was not so fortunate; the patients died, in some cases, from pre-existing peritonitis, the real nature of the tumour not being detected till after death. Velpeau relates a case in which he was on the point of operating: the patient died from partial peritonitis, with the formation of small abscesses; but the peritoneum connected with the tumour was not inflamed.

When the tumours have been cut down

upon, under the supposition of their being hernial, and excised, the symptoms have yielded at once; a circumstance which would seem to show, that of themselves, they do, in some instances, either by their traction on the peritoneum, or, the strangulation of their pedicle, give rise to symptoms simulating an incarcerated hernia.

The most important of the outlets of the abdomen, possessing high surgical interest in relation to the occurrence of protrusions, are situated between the ilia and pubis, corresponding to the lower border of the moveable abdominal wall. The minute description of these openings is reserved for the article Groin. (See also Hernia.)

The cutaneous surface of the abdomen presents the same general characters as the skin of other parts of the body. As we have already remarked, it is calculated by its structure, to add strength to, and to favour the free motion of the parts it covers. On the posterior region of the abdomen, it is thicker and less sensitive than on the anterior. At the age of puberty, the skin covering the pubis, and the neighbouring parts is furnished with hair. The integuments of the abdomen are subject to all the changes which affect the other structures, in consequence of the variations of volume in the contained organs; thus, after uterine gestation, and certain diseases of the organs in the abdomen, upon the removal of the cause of distension, the skin having lost in some degree its elasticity, falls into furrows or wrinkles, which assume a transverse direction.

The structure and organization of the abdominal parietes having been thus rapidly sketched, we may now make a few observations on the aspect which they collectively present. It has been already stated that the abdomen in front presents to the eye a contour of an ovoid form; but it is difficult to fix its just limits externally, on account of the continuity of the soft parts with those of the thorax: but though indistinct, the frame work nevertheless may be made sufficiently prominent, to assist us in dividing the whole into certain portions, to which we shall advert presently.

The general form and comparative size of the abdomen to the other cavities of the body varies at the different epochs of life, and the capacity of its cavity seems to bear some relation to the quantity and kind of food taken; hence it is found, that in the infant the cavity of the abdomen is larger than at any other period of life, corresponding to the relatively greater quantity of food then required; while in old age its capacity is lessened when the activity of digestion is diminished, although its external parietes frequently, at this period, become distended by an accumulation of fat. In the two sexes also there is considerable difference in the form of the abdomen, being proportionably smaller and shorter in the male than in the female, more particularly in the lower part; the width of the ilia in women is also greater than in men.

Surgical regions, or sub-divisions of the abdomen.—Certain arbitrary divisions have been arranged with a view to assist the surgeon in forming a diagnosis, and directing his operations as emergency may require. These divisions are equally valuable to the physician in guiding his explorations of the abdominal organs. Velpeau's plates are sufficiently clear to answer our purpose in tracing these divisions, and we accordingly reproduce them.

Fig. 2.

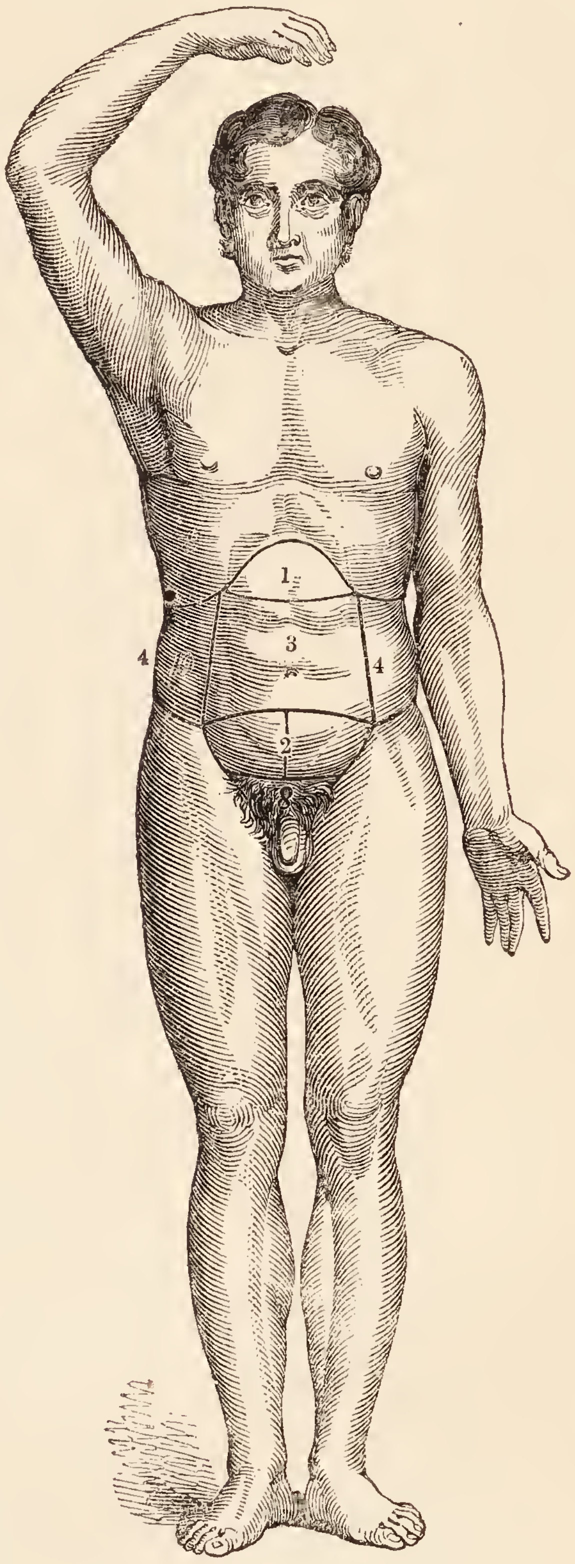
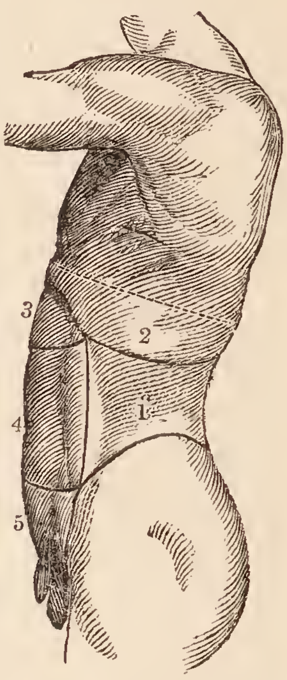


Fig. 2 represents the front of a human figure, exhibiting the regions of the abdomen. The curved line running across the middle of the body, above the small division (1) marks the limits of the two great splanchnic cavities respectively. Another line drawn from the crista of the ilium on one side descending in the fold of the groin, crossing the pubis under (2), and ascending the fold of the groin of the opposite side, till it reaches the crista, marks the limit of the moveable wall of the abdomen below. The line traced on the edges of the lower ribs, and passing under (1), and that corresponding to the cristæ of the ilia, and running above (2), form three large zones, which are again subdivided into regions. The first of these zones comprises two lateral regions, the right and left hypochondria, and a central one, the epigaster. This last (1) occupies the space between the diverging ribs; at its upper part, the xiphoid cartilage is felt. The aponeurosis here is thin and weak; its resistance to protrusions is, however, sufficient, there being but little pressure from the internal organs, except under circumstances of great distension. Abscesses of the mediastinum sometimes point here; its own cellular tissue may also be the seat of a purulent collection, which may fuse in the direction of the *linea alba*. Distressing pulsations simulating aneurism are sometimes felt here, particularly by hypochondriacal and nervous persons; they may arise from the throbbing of the cœliac artery, or what is much more common from nervous twitchings, similar to those which occur in other parts of the intestines, the cæcum and colon more especially. We shall notice the other two regions, when we speak of their relation to the internal organs.

The second zone, the umbilical, is subdivided into a central, (3), and two lateral regions, (4, 4). The umbilicus is placed in the centre of this zone; the skin is intimately adherent to this organic remnant, in consequence of which, when the walls of the abdomen become loaded with fat, it sinks in, and forms a funnel shaped depression. The obliteration of the umbilicus is often so imperfect at birth and in the early months of existence, that the intestines, by passing into the unobliterated cul de sac, elevate it into a tumour, which gradually diminishes as the child grows; later in life, the umbilicus presents a fibrous knot, so much more resisting than the surrounding parts, that Scarpa believed the protrusion of any part of the intestinal tube through it, to be impossible. The surrounding parts, however, and especially after excessive distension, may be very much weakened, and their fibres so separated, as to facilitate protrusions. The fatty herniæ, of which we have already spoken, are liable to occur in this region, owing to the small openings occurring here and there in the tendinous layers of the muscles (See Hernia); the tendinous intersections of the rectus muscle are remarkable in this region; Velpeau considers, that they quintuple the strength of the muscle. The arteries of this region possess some surgical interest, in the operations of paracentesis, and hysterotomy (see those articles). When incisions are had recourse to, it is a rule to cut in the direction of the fibres, which being straight in this region, the incisions should be straight also. The iliac vessels on the lateral limits of the region may be of such a size, as to furnish a good deal of blood. Incisions on the median line may generally be entitled to a preference, and even Sir A. Cooper has been heard to regret, that he had not made his incision in this situation, upon the occasion in which he tied the abdominal aorta. The two lateral portions of this zone are, the lumbar regions; they occupy the open space between the margins of the false ribs, and the crista of the ilium, extending backwards under the longissimus dorsi; a part only of it therefore is seen in the front view of the abdomen. Its entire extent is shown in the next figure (1), together with the left hypochondrium (2), and a portion of the epigastric (3), umbilical (4), and hypogastric (5) regions in profile.

Fig. 3.



The cellular tissue of this region communicates under the twelfth rib with that of the cavity of the thorax, and may be the seat of congestive abscess in consequence of caries, either of the ribs or vertebræ. Other abscesses of a nature less serious occurring in this situation may be confounded with one of a symptomatic character. Velpeau mentions two cases of chronic idiopathic abscess, in one of which the life of the patient was saved by a free opening, followed by speedy cicatrization of the sides of the purulent cyst.

At the back part of this region, there is a weak space sometimes left behind the thin edge of the internal oblique, and the transversalis, which with the thin lumbar aponeurosis may yield before the pressure of the abdominal viscera. J. L. Petit mentions his having seen a case of hernia in this situation. Callisen, from having observed the thinness of the abdominal covering at this point, proposed selecting it as a proper place to establish an artificial anus, in the case of infants born with imperforate rectum. Anthrax and phlegmon are not unfrequent in this region, which is clearly attributable to its abounding in cellular tissue. Urinary fistule from the kidney is sometimes, though rarely, observed in this region. Moxæ, issues, &c. are some of the surgical applications that may be here employed.

The third zone is the lowest, and may also be divided into its centre ((2), plate 1) the hypogastric, and right and left inguinal regions. Some of the most important operations in surgery are performed on these regions: for instance, the operations for strangulated hernia, for puncturing the bladder, the high operation of lithotomy, &c. Secondary abscesses from violent cystitis, sometimes occur in the cellular tissue of the hypogaster; matter formed after psoitis, or from disease of bone, as in congestive abscess, often point in the inguinal regions. (See Groin and Hernia.)

In the posterior view there is nothing to correspond, with the upper and lower zones, observed in the front view. Here, strictly speaking, there is but one zone for the abdomen contained within the limits of the curved line which separates it from the thorax above, and the gluteal regions, marked by two arched lines extending from the median line of the sacrum, upwards and outwards over the ridges of the ilia.

Fig. 4.

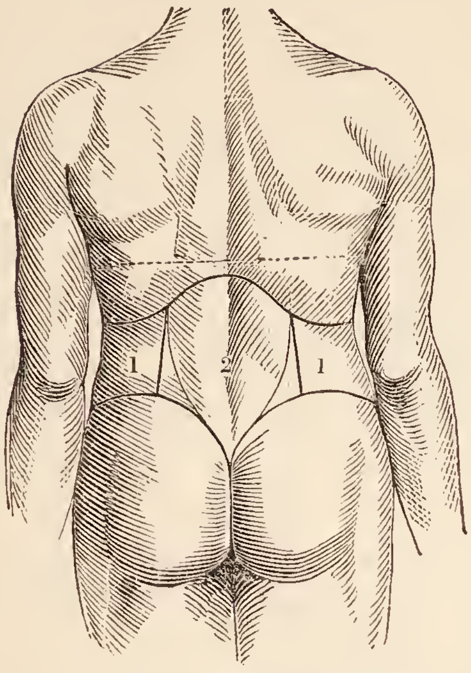


Fig. 4, shows the posterior portions of the lumbar regions (1, 1); and (2) the centre of this zone. The dotted lines show the ascent of the cavity of the abdomen within the basis of the thorax.

In terminating our description of the parietes of the abdomen, we should remark, in the distribution of the parts entering and issuing from the cavity, what great care has been bestowed, in guarding against protrusions of its contents. An illustration may be borrowed from a comparision of the cavities of the thorax and abdomen. In the former, a state of permanent distension, provided for in the structure of its partly bony walls, resists the extremes both of distension and collapse. When the muscles have dilated the chest, the capacity of the air-cells of the lungs is augmented, and the air rushes down the trachea; the dilating effort being now suspended, the elasticity of the bones of the thorax, and of the lungs themselves, is sufficient to expel the air out of the chest; but to both these states there is a limit which is soon attained. The opening by which parts are allowed to pass into this cavity is large, the tendency of the contained parts to protrude being comparatively slight. In the latter, the reverse is the case; the tendency of the organs to escape from the pressure which they are undergoing in every direction, is so great that it requires to be counteracted by the dissemination of the organs to be transmitted, over different points. The parts transmitted are visceral, vascular, nervous, or cellular. Now, if but one opening existed for the transmission of all those parts, protrusions from the upper or lower boundary of the abdomen, would be constantly occurring.

Before we pass from the walls of the abdomen to the organs they enclose, let us examine against what point of those walls the pressure of the internal parts must be chiefly directed. The axis of the cavity is not perpendicular. The slight inclination backwards of its upper extremity, and the still deeper deflection, backwards and downwards, of the lower one, to form the excavation of the pelvis, oblige us to consider the direction of a separate axis for each. This difference of direction is advantageous in decomposing the superfluous force of muscular action. The direction of the superior axis in the erect posture will correspond to that of a line drawn from the centre of the diaphragm to the pubis; that of the pelvic portion, ascending from the coccyx, will bisect the long axis at a point about midway between the pubis and umbilicus. The relative directions of both will vary of course according to the different attitudes. In this position, as well as in the attitude of kneeling or riding, all the force of the muscular bag, constituting the walls of the abdomen, is concentrated at its lowest part; thus pressed upon, the viscera are naturally impelled along the inclined plane formed by the iliac fossæ, against the crural arch and the sides of the pubis. But when the body is bent forward, as in the act of expelling the fæces, the two axes, instead of forming an obtuse angle at their point of junction, come nearly into the same line; the direction of the force, instead of being in the line of the pubis, points towards the coccyx.

We shall see on examining the internal organs, the provision made to obviate the effects which would be likely to result from this direction of the pressure against the lower part of the abdominal walls, by relieving them from the weight of the viscera themselves.

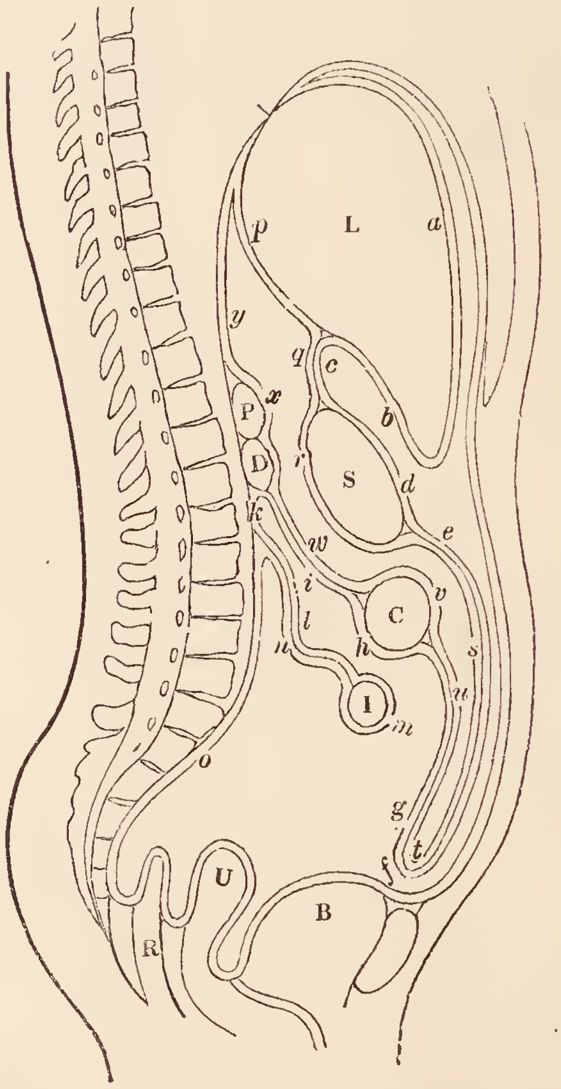
The proportion between the power of the muscles and the resistance of the viscera is so justly poised, that except under circumstances of unusual violence, there is no liability to injury to either the one or the other Unyielding rigidity of the walls exposes the internal organs to laceration. A horse strains violently under his load, and drops down dead,—the aorta is ruptured. A person falls from a height, the muscles contract violently, and the liver or spleen is ruptured. In other circumstances this rigidity may have a protective effect. A person falls from a vehicle heavily laden; the wheels passing over his abdomen, the internal organs are uninjured; the violent contraction of the muscles has enabled the abdominal viscera to escape the crushing which must have otherwise been mortal. A fatal lesion may even be the consequence of the opposite condition. The abdominal walls are totally relaxed; their suppleness and elasticity is such as to enable them to transmit the action of a contunding force to the internal organs, capable of destroying them, while they themselves remain uninjured. Mr. Jobert relates a case, in which a person with an irreducible hernia received the kick of a horse in the abdomen. He had the usual symptoms of fainting, vomiting, &c. of strangulated hernia; an operation was performed which was useless; the jejunum, after death was found to be completely divided.

Internally, the abdomen forms a perfect cavity, the boundary of which is everywhere traceable, and is lined throughout by a serous membrane called the peritoneum, which, by prolongations within itself, more or less completely invests the several organs, and thus suspends and maintains them in their respective regions. This serous membrane consists of two sacs, the larger one being that which is opened in a section of the parietes, and the smaller one, that which is behind the stomach, and which is consequently hidden from view. The two sacs are continuous with each other, behind the right edge of the omentum minus, at the opening called the Foramen of Winslow; and therefore there is virtually but one sac, which by reason of its arriving at the various organs, and by climbing up the vessels which supply them, assumes an arrangement which at first sight appears complex.

The larger sac extends from the base of the anterior aspect of the liver (where it forms a cul de sac by its reflexion from that organ to the diaphragm), to the pelvic outlet, where it again forms one or more cul de sacs by its reflexion from the rectum to the bladder in the male,—and from the rectum to the vagina, and from the uterus to the bladder, in the female. It covers the convex surface of the liver (*a*), and its concave surface (*b*), as far as the transverse fissure; next, it forms the anterior layer of the omentum minus (*c*), being in front of the hepatic organs; then it furnishes the anterior covering of the stomach (*d*), which on the left side creeps along the splenic artery to pass around the spleen, and, by its being reflected from that organ to the left crus of the diaphragm, it loosely binds it against the posterior wall; from the stomach it descends on the omental branches of the gastro-epiploic vessels, and constitutes the first or anterior layer of the omentum majus (*e*); this layer turns backward, and ascends (*f*) as the fourth or posterior layer (*g*) of the same omentum, until encountering the colon (C) crossing the abdomen, it adheres to that part (*h*) which is posterior to vessels which supply it; it then passes upwards and backwards (*i*, *k*) to the spine, to which it is fixed, forming the inferior layer of the transverse meso-colon; it again changes its direction and turns downwards, but it is now fixed, being in front of the aorta, vena cava, and part of the third portion of the duodenum; at an oblique line drawn from the left side of the second lumbar vertebra towards the right iliac fossa, it ceases to be fixed, and advances on the front of the superior mesenteric vessels (*l*) to the jejunum and ileum (I); and, at the point where the vessels enter, it passes around the intestine (*m*, *n*) to the posterior part of the same vessels by which it is conducted to the spine, these two portions forming the suspensory of the small intestines, or the mesentery (*l*, *n*); it then descends (*o*) into the pelvis, where it is in a fixed state, but by tracing it from one side to the other, it will be observed that on the middle line it becomes loose, advances to the posterior part of the rectum, passes around the surface of that viscus to the same point, and retires to the sacrum, constituting the meso-rectum, between which the internal hemorrhoidal artery insinuates itself; from this point it passes on either side attached to the walls of the pelvis, and to the posterior surface of the bladder, from the fundus of which it becomes continuous with the lining of the anterior parietes of the abdomen.

The obliquity of the attachment of the mesentery will admit of our designating the two laminæ of which it is formed, the one as the superior or right, the other as the inferior or left lamina; the former passes to the right side on the ilio-colic, right colic, and middle colic arteries, and at the spot where their distribution to the cæcum and ascending colon commences, it passes around those parts of the great intestine to the opposite side of the vessels, and it is then reflected outwardly on to the walls of the abdomen, the two laminæ being termed the right colic ligament: the latter passes to the left side along the left colic and anastomosing colic arteries to the descending colon and its sigmoid flexure, where an arrangement similar to that of the right side obtains.

Fig. 5.



L, *the liver;* S, *the stomach;* C, *the colon;* I, *the ileum;* P, *the pancreas;* D, *the duodenum;* B, *the bladder;* U, *the uterus;* R, *the rectum.*

The smaller bag, that which is behind the stomach, may be considered as a pouch of the greater bag thrust through a ring behind the vessels of the liver. It extends from the base of the posterior aspect of the liver to the point where the first or anterior layer of the great omentum changes its direction, and becomes the fourth or posterior layer. It also forms a cul de sac against the spleen, where it is bound to the left crus of the diaphragm. At its upper part it is reflected from the right crus of the diaphragm to the liver, and assists that formerly mentioned to sustain that organ; it covers the lobulus spigelii (*p*) and at the posterior lip of the transverse fissure it becomes loose, descends (*q*) behind the hepatic organs to the stomach, forming the posterior layer of the omentum minus; this layer descends adhering to the posterior surface of the stomach (*r*), and by the aid of the anterior layer suspends that viscus from the porta of the liver; from the stomach it descends behind the omental vessels, being the second layer (*s*) of the great omentum; at the point (*t*) when the exterior layers form a cul de sac, it also changes its direction and ascends as the third layer (*u*), until it arrives at the transverse colon (C), the anterior surface of which (*v*) it covers; from hence it passes loosely to the spine, forming the superior layer (*w*) of the transverse meso-colon; as the inferior layer (*i*) of this transverse meso-colon turns downwards from this point, and became fixed, so this superior layer (*x*) turns upwards and becomes fixed, it being adherent to the anterior surface of the pancreas (P), from which, in fine, it passes to the right crus of the diaphragm, the point at which the description commenced.

After thus tracing the peritoneum, as it suspends and attaches the abdominal organs, we may return to the regionary divisions, and enumerate rapidly the organs appertaining to each; the value of this mode of studying the cavity will now be apparent, as the correctness of our diagnosis in lesions of these organs, will often depend on our ability to point out their precise positions.

In the epigaster, we find the largest portion of the left lobe of the liver, the lobulus spigelii, the right portion of the stomach with the pylorus, the first and second divisions of the duodenum, the pancreas, and upper part of the great omentum, the vena porta, the splenic and superior mesenteric veins, the vena cava, the aorta, and cœliac axis, and around them, the large solar plexus, the great centre of the nerves of organic life, forming, as Cruveilhier happily expresses it, in itself "an abdominal brain," the vicinity of which to the scrobiculus cordis, may account for the exquisite sensitiveness with which in some individuals this point is endowed, and the sense of pulsation, fluttering or sinking, which are sometimes ascribed to the existence of an aneurism, or to some organic affection of the liver or stomach. We find also the transverse arch of the colon; and at the back part of the region, a portion of the vertebral column and thoracic duct.

The right hypochondrium is filled by the liver, the gall-bladder, the angle formed by the first and second portions of the duodenum, a portion of the vena cava *above*, and the upper extremity of the right kidney *below*. This organ may be explored, under the cartilaginous edges of the false ribs.

The left hypochondrium contains the great cul de sac of the stomach, its cardiac orifice, with the pneumo-gastric nerves spread out upon it, a small prolongation of the left lobe of the liver, and the spleen attached to the stomach, by the gastro-splenic epiploon, the tail of the pancreas, and a portion of the arch of the colon, as it is continued to the descending colon. In the enlargements, either of the spleen or liver, these organs project from beneath the edges of the ribs. The spleen is sometimes so enlarged as to descend to the iliac region. This condition is observed more particularly after long standing intermittent fever, and is known under the name of *ague-cake*. Whenever such enlargement of either of these viscera occurs, they may be felt beyond the range of the hypochondria. Under these circumstances, they will of course be much more liable to rupture from falls or blows, than when they enjoy the protection of the ribs. In the fœtus, and even after birth, the liver, from being relatively larger than it is in the adult, is exposed to rupture from the deficiency of this protection.

The umbilical region is occupied by the great omentum, the convolutions of the small intestines, with its mesentery including its lymphatic ganglia, lacteals, and blood-vessels, the vena cava, and abdominal aorta, and the vertebral column.

In the right and left lumbar or renal regions, are seen the ascending colon for the right, and the descending for the left, a portion of the convolutions of the small intestines, and behind the colon, the kidney, and a portion of one ureter for each of the regions.

The hypogastric region shelters the inferior convolutions of the small intestines, the pelvic portions of the ureters, and deep in the excavation of the pelvis, the bladder in man, the bladder and uterus with its appendages in the female, in both the rectum.

The right and left iliac regions contain (the right) the cæcum with its appendix, and the commencement of the colon, forming by their continuation with each other, the ilio-cæcal valve, the bifurcations of the aorta and vena cava; (the left) the sigmoid flexure of the colon, and commencement of the rectum. In cases of imperforation of the anus, or of alvine concretions blocking up the rectum, it has been proposed by Monro the Second to open the abdominal wall of this region with a view to the formation of an artificial anus. Mr. Pring performed this operation in a case of schirrhous rectum. M. Duret, in a case of imperforate anus, arrived at the S of the colon in this manner, carrying it out through the lips of the external incision, for the purpose of establishing an artificial anus. It appears, he opened the peritoneum; an inconvenience which he might have very easily avoided by reaching the intestine, and opening it on the posterior surface. This operation differs from that of Callisen, which attacked the colon higher up, and from the back part of the lumbar region. It is through an opening in this region also, that the iliac arteries are tied. Some of the ablest surgeons, Abernethy amongst others, recommend the incisions to be made in an oblique direction from the groin to the flanc, in order to avoid wounding the epigastric and circumflex arteries.

We should now consider the relations of the peritoneum to the contained organs, some of which it loosely suspends, while it firmly binds down others. With respect to the mode of these attachments, they may be divided into three orders; namely, organs that are fixed, organs that are floating, and a third class in which these two qualities are for the purposes of function associated, and in which the organ undergoes such changes, as to be free and prominent at one time, and fixed and hidden at another.

In the first class, we may place the kidneys with their appendages, the liver, pancreas, and spleen; these are the organs that suffer most from the shock of falls, blows, or counter-violence, and the effect may be easily understood. They are soft in texture, and their power of yielding is limited; two conditions which render them highly susceptible of the influence of shocks upon other regions of the body; and thus we see explained the effect of a fall on the head in rupturing a bulky and soft organ like the liver. In the second class are the small intestines, the arch of the colon, and the large omentum. In the third class, we enumerate the stomach and duodenum, the uterus and its appendages, the bladder and rectum: all these organs dilate from their fixed points, and when thus dilated extend into vicinal, and even into remote regions. Thus the stomach when distended presents its large curvature to the anterior wall of the abdomen, when collapsed, its anterior surface; the bladder ascends above the pubis, sometimes attaining a height above the hypogastric region; the body of the uterus, in the progress of gestation, quits the cavity of the pelvis, its fundus reaching as high as the epigaster. In these dilatations, one thing is worthy of remark; namely, that the distended organ maintains a close relation with the anterior wall of the abdomen. The same observation will apply to ovarian or other tumours developed within the abdominal cavity.

Although, as a general rule, tumours developed in the cavity of the abdomen are in immediate relation to the anterior wall, some interesting observations are recorded by Dr. Baron of Gloucester, in the Medico-Chirurgical Review, (No. 29, 1831) in which the paracentesis of these tumours would have been inevitably attended, in the one instance by puncture of the stomach, in the other with that of the bladder; these organs being interposed between the tumours and the anterior wall. The fact was ascertained by the cadaverical examination. (See PARACENTESIS, OVARIES.)

We may now have some notion of the important office which the peritoneum performs in regard to the organs of the abdomen. Some it binds down firmly; to others it gives a range of space in which their natural peristaltic motion may have free play; whilst to a third class, it gives a momentary power of expansion to be again confined within their original narrow limits: all which it effects without intricacy or confusion, by successively suspending the different organs over various points of the abdominal cavity, in such a manner as to prevent the weight of the incumbent viscera from adding to the force of pressure against the weak points of the abdominal walls, and which without this precaution would be often overwhelming. How truly admirable must that arrangement be, by which (not to speak of other organs) an intestinal tube, ever-varying in its diameters, equalling in its length, six times the height of the individual, is folded into convolutions which maintain contact without confusion, and which mix and move perpetually without knotting with or impeding each other!

One word more on the elasticity and extensibility of the viscera and walls of the abdomen. In the enormous development of the abdominal parietes, as in ascites; or of both parietes and viscera, as in tympanitis, although the distention may be excessive, the intestines are never ruptured from this cause, but the walls of the abdominal cavity may be so overstrained as to be rendered incapable of quick and perfect resiliency upon the organs, on the sudden removal of the distending cause. This loss of elasticity in the walls involves the loss of due pressure upon the viscera; the secondary effects of which may be very serious. In ascites, the abdominal circulation is sustained in relation to the presence and pressure of a large accumulation of fluid; let this fluid be suddenly removed by paracentesis, without any precaution being taken to continue the accustomed pressure artificially, the abdominal vessels being freed from the pressure of the mass of fluid become highly congested, the blood is returned but languidly to the heart, the centre of the circulation flutters, the pulse becomes unsteady and small, and syncope, and even death may supervene. After parturition, too, where the distension has been excessive, the effects of the sudden abstraction of pressure are observable, and may continue for weeks, the woman complaining of pains in the loins, weakness, bearing down, loss of appetite, and wasting. The function of the abdominal parietes is in abeyance, and must be represented by a circular bandage applied with moderate tightness round the abdomen. These excessive distensions, however, it should be remarked, have the effect of weakening the abdominal walls, thinning the muscles, and slitting the aponeurotic fibres, and thus of increasing to a great extent the liability to protrusions of the viscera.

The organs contained in the cavity of the abdomen suffer from displacement; we are not now alluding to the case of a transposition of the viscera, but to the displacements known under the general denomination of herniæ, under which head they will be more properly placed in a work of this kind.

Abscess in the walls of the Abdomen.—The principal purulent collections of the abdomen fall under consideration in the general article, ABSCESS, PSOITIS, URINARY EXTRAVASATION, &c. In this place we shall only offer a few general reflections on the subject.

The cellular tissue of the moveable abdominal walls is sometimes the seat of anthrax, furunculus, and abscess. The pus may form in the cellular substratum of the peritoneum, between the muscles, or, in the case of anthrax, immediately under the skin. The development of these collections is attended with fever and excessive pain, aggravated by the movements of the abdominal parietes; from the resistance they meet with from the muscles and aponeuroses, they are at first flat, and but slightly elevated, having a tendency to be diffused, rather than to point; they make their way to the surface but slowly, and at last, when they reach it, they often become sharply acuminated; when opened, the matter that issues is in general highly offensive. The walls surrounding the abscess remain engorged and hard for some time after the evacuation of the pus. The fetor of the pus resembles that of fæces; a point which it is proper to mention, to guard against the inference that it might arise from a communication between the purulent collection, and the cavity of an intestine. In the early stage, the formation of the matter should be combated by vigorous antiphlogistic treatment; when formed, the matter should be let out as soon as fluctuation is discerned, to prevent the extensive separation of the layers of the abdominal walls.

Wounds of Abdomen.—This branch of the subject must also be reserved for another place (see Wounds); a few general observations only will be offered for the present, and merely with a view to illustrate the protective functions of the abdominal walls. We must again advert to the comparison of the cavities of the thorax and abdomen. In the former, the state of permanent extension, with the alternate limited contraction and dilatation of its parietes, renders the introduction of air into it inevitable, whenever a penetrating wound is inflicted upon it. In the latter, the reverse of this obtains: the balance of pressure and resistance between the walls and viscera is so well adjusted, the alternations of distension and collapse in the internal organs, are so accurately and constantly measured by the parietes, that no vacuum is permitted. Until the time of John Bell, surgeons entertained great apprehensions as to the effects of air admitted into the abdominal cavity; he exposed the fallacy on which this opinion was grounded, in his observations on Monro's work on the Bursæ Mucosæ. Cloquet has made experiments on animals, the results of which are confirmatory of the ideas of Bell on this subject. These apprehensions, however, should be set at rest, by what we observe in the incisions, and extensive manipulations of the intestines, in operations on the ovaries, in the Cæsarian section, eventrations, divisions of hernial sacs, &c. In a penetrating wound of the abdomen, the admission of air is all but impossible, as directly the wounding instrument is withdrawn, some portion of the moveable viscera instantly fills the aperture.

The exclusion of the air, or the mode in which it is effected, is indeed less a point of interest than the rapid glueing together of the wounded parts. This property of rapidly exhaling plastic lymph will be fully considered in reference to purulent collections in the article Abscess; at present we shall content ourselves by briefly alluding to it. The property of exhaling the elements of adhesion, in conjunction with the universal pressure of the viscera upon each other is such, that a weapon may pass through the cavity of the abdomen, wounding both blood vessels and intestines, and yet there may be no extravasation, either from the one source or the other. Hennen, in his Treatise on Military Surgery, relates the case of a soldier who recovered after a wound from a ramrod, the end of which stuck so fast in the spine, that considerable force was required in pulling it out. Before Bell's time it was supposed, that the weapon pushed the intestines aside, and passed without wounding them; but "we now know," says he, "that in a thrust across the abdomen, six turns of the intestine may be wounded; each wound may adhere; adhesion we know is begun in a few hours, and perfected in a few days, and when it is perfect, all danger of inflammation is over, and when the danger of inflammation is over, the patient may walk about." For more ample details on the agglutination of serous membranes, see Adhesion. Extensive wounds of the abdominal parietes give rise to large eviscerations, to which, although a cicatrix may be formed, the person remains liable ever after, the cicatrix being inextensible and weaker than the rest of the wall. In wounds that do not penetrate the cavity, it is impossible to determine, *à priori*, whether the case may be serious or otherwise; they may be followed by no symptom of importance, healing up in a few days without subjecting the patient to any inconvenience; or inflammation may arise and threaten to become extensive: they are often excessively painful, owing to the lesions of the nervous twigs with which the abdominal parietes are so plentifully supplied. It should be the surgeon's chief care to protect the patient against the occurrence of traumatic peritonitis, by the free use of antiphlogistic remedies, which should be carried as far as the patient's strength will justify. (See Wounds.)

Contusions of the abdomen from blows, &c.—These may interest the parietes alone, when they are termed simple; or they may affect one or more of the internal organs, when they are said to be complicated. The subject involves the consideration of the protection which the parietes afford to the contained organs. We have already alluded to this portion of the subject. The universal contact of the contained organs with the parietes, exposes them to the effect of external violence, more especially when it falls on the moveable walls. The peritoneum has been known to be completely divided by a blow, giving rise to a protrusion of the viscera, without a covering from this membrane. A cannon shot may impinge upon the surface of the abdomen, and reduce the intestines to a mass of pulp, without leaving any external trace whatever. Injuries like these are coincident with a relaxed condition of the abdominal walls; even the contents of a hernial sac have been ruptured by a blow, without leaving the slightest trace of injury in the integuments. Both the spleen and liver may be thus ruptured, and even the gall bladder, giving rise to a fatal extravasation of bile. The bladder and uterus can only be ruptured while in a state of distension. The stomach has also been ruptured, but the accident is very rare; rupture of the small intestines is not so unfrequent: the liability to this accident, *cæteris paribus*, will be relative to the degree of distension and density, as well as to the power of resistance of any given viscus. When the walls of the abdomen contract firmly, and prepare themselves, as it were for a blow, the protection to the internal parts may be effective. Some men are able to endure heavy blows on the abdomen, without shrinking, merely by throwing the recti muscles into strong contraction. Solutions of continuity may also occur in the muscles, or tendinous sheaths themselves, without any breach of the skin from blows, or from the efforts of straining in any way, such as coughing, vomiting, &c., more particularly, when the parietes are already thrown on the stretch from uterine gestation, ascites, tympanitis, or ovarian dropsy. They become sometimes morbidly fragile towards the end of typhoid fever, and are easily torn in the efforts which the patient may make during delirium. The abdominal organs are also liable to rupture from internal causes. Rostan has observed, the peritoneal coat of the intestines torn in some of the aged females at the Salpetrière, from constipation. Marjolin and Velpeau have seen the same effect produced by strictures of the intestines, on both the peritoneal and muscular coats. The simple contusions of this region are not attended with danger, and require no particular remark. (See WOUNDS, *contused.*)

Effusions into the cavity of the abdomen.—It has been already stated that the fulness of the abdominal cavity, and the pressure of the contained organs on each other have a powerful effect in checking effusion or extravasation, as they also undoubtedly have in limiting it when it has taken place. The fluid poured out, either slides into the nearest interstices of the convolutions, where it coagulates if it be blood, or if the quantity be considerable, forms a sheet in the neighbourhood of its source, and gradually works its way towards the opening in the parietes, if there be an external wound: it seldom yields to the effect of gravitation alone on account of the influence of other contravening causes. The matter extravasated may be blood, aliment, bile, chyme, pus, fæcal matter, urine, &c. When blood alone is effused, and in small quantity, the risk of life may be comparatively small, but when any of the other fluids are extravasated, life is quickly destroyed by rapid and violent peritonitis.

Fistulous openings are sometimes established in the walls of the abdomen, extending in the course of the cellular expansions, or communicating with the internal organs themselves, such as the stomach, gall-bladder, different portions of the intestines, &c., the fistulous tracks being carried completely into these viscera, by means of adhesions. (See FISTULÆ.)

The subject of protrusions of the contents of the abdominal cavity will be treated of under HERNIÆ. The general rules for exploring the viscera, are given in the article ABDOMEN, in the Cyclopædia of Practical Medicine. To the physical signs for the guidance of diagnosis there laid down, we shall add one which has been established by Dr. Bright, since the publication of that work. This sign is *a crepitation* which is felt under the fingers, and is indicative of abdominal or peritoneal adhesions. Dr. Bright states that it is only felt during a certain time, and is transitory. The symptom itself is of some importance in surgery, as it may guide and give confidence to the surgeon, in opening collections which tend outwards from the cavities, under the isolation of these adhesions, to be voided at the surface. In collections of matter in the liver, for instance, the surgeon should examine carefully and frequently, in order to detect this sign. Dr. Bright observes, "When the circumstances of the disease have rendered it probable that adhesions are established between the viscera, and the peritoneum of the parietes, the touch gives a peculiar sensation, varying between the crepitation of emphysema, and that which would be produced by squeezing new leather between the fingers." Dr. Bright has had numerous opportunities of satisfying himself of the correctness of this sign.

The anatomical and physiological considerations appertaining to the subject of Abdomen, will be found in fuller detail, in the article treating of it, in the Cyclopædia of Anatomy and Physiology.

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(Bransby B. Cooper.)

ABLACTATION, *ablactatio*, Lat., *weaning*, Eng.—Ablactation in the Latin language means *weaning*, and refers to the child. In medicine, however, the effects which are produced by the spontaneous or compulsory cessation of the secretion of milk deserve to be considered ;—1. in reference to the mother ; 2. in regard to the child. (See LACTATION.)

ABLATION, *ablatio*, L. from the verb *aufero*, to take away, which makes *ablatum* in the supine. In its general acceptation it expresses the separation, extraction, violent removal, or plucking away of any part that may be superfluous, inconvenient, hurtful, or foreign to the body. Hippocrates applied it to any sort of evacuation, the emission of blood for instance. In operative medicine it is used less to designate one of the various modes of *exeresis* than as a generic name for all forms of *amputation* and *extirpation*, which may be regarded as two species derived from it. Some surgeons employ the term in a more restricted sense, when they speak of the ablation of an exostosis, of a portion of carious or necrosed bone, &c. The ablation of parts is sometimes designated by particular words indicative of the manner in which it is effected, such as *excision*, *resection*, &c. or of the consequence of the ablation itself, such as *circumcision*, *castration*, &c.

W. B. C.

ABORTION (*obstetricy*), *abortus*, *aborsus*, *affluxio*, Lat. Διαφθορὰ, ἐκτρωσμὸς, Gr. *avortement*, Fr. *Fehlgeburt*, Ger. *aborto*, Ital. *aborto*, *malparto*, Span. *miscarriage*, Eng.

Definition.—The expulsion of an embryo or fœtus[1] from the uterus before the sixth month of gestation, at which period of existence it cannot survive to maturity, and is therefore generally considered non-viable[2].

The expulsion of a fœtus after the sixth month of uterine gestation is termed premature labour, as the phenomena and treatment of such cases are the same as in natural parturition, and as the infant may survive for some time.

From the time of Aristotle down to the last century, the expulsion of the ovum from the uterus before the seventh day has been often designated *effluxion*, and after this age and before the fortieth day, *abortion*. Bonaciolus held this opinion : " Effluxiones quæ intra diem septimam ; aborsus quæ primis mensibus ; abortus quæ intra quadragesimam[1]." These distinctions are, however, arbitrary and insignificant, and have been long disregarded.

Abortion or miscarriage may occur at any period of uterogestation, but it is much more frequent during the first two or three months. It is generally admitted, that at this time the slight connection between the embryo and the uterus, the increased afflux of blood to this organ from the moment of conception, and according to some authors, the hemorrhagic effort at the menstrual periods render women very liable to abort.

It is stated by some obstetricians, that the greatest number of abortive fœtuses is of the female sex, though the contrary is more generally supposed to be the case. Morgagni satisfactorily refuted the former opinion. According to him, the excessive development of the clitoris at the early age just mentioned, might be readily mistaken for the external male organ of generation.

Madame La Chapelle states, that of 21,960 pregnancies, there were 116 abortions, and these were more frequent at the sixth month than at the fifth, and next at the third, than at any other period of pregnancy. The more general opinion, however, is that abortion is of more frequent occurrence in the earlier stages of pregnancy. According to my own observations, abortion is most common from the second to the fifth month after conception.

M. Velpeau endeavours to reconcile these conflicting opinions, by stating, that abortion is productive of such little inconvenience in the first months of pregnancy, that many women were not admitted into the Maternity for that disease, or that the ovum or embryo was frequently confounded with sanguineous clots, which led patients to suppose they had only a return of menstruation.

Causes.—The causes of abortion are remote and proximate, or *efficient* and *determinant*. The efficient or proximate are the contractions of the uterus as in natural parturition, aided by the efforts of the abdominal and respiratory muscles. The remote or determinant causes may be subdivided into *predisposing* and *occasional*.

The predisposing causes may affect the woman or the fœtus respectively. As regards the woman, some belong to the organism in general, others to the sexual organs in particular ; and as regards the fœtus, to a particular or anormal disposition of its organization, or to its diseases.

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[1] The term " embryo" is used in obstetricy to designate the impregnated ovum, during the first three months of intra-uterine existence ; that of " fœtus" from that period to the end of gestation.

[2] There are, however, cases on record of infants born at the age of four months and half, which were said to have arrived at the adult period of life ; and the parliament of Paris decreed that an infant born at the fifth month was capable of living the ordinary period of human existence. Fortsimons related a case of an infant born at five months and a half, which survived for some years ; but the opinion of modern obstetricians is, that this fœtus was older. A large majority of physiologists and medico-legal authors agree in the conclusion, that infants born before the completion of the seventh month have a very slender chance of surviving ; and many contend, on this ground, that no conviction for infanticide or concealment of pregnancy ought to take place in such cases. It is to be remembered, however, that the embryo is a living being from the instant of conception, and that abortions or premature deliveries are comparatively few in proportion to natural parturitions ; and therefore that the existing law is humane and just. If the contrary opinion obtained, it might be as fairly argued that all feeble and delicate infants might be destroyed after birth, as was ordained by the laws of the ancient Spartans.

[1] De Formatione Fœtûs.

Diseases of the Woman.—The persons in general most predisposed to abort, are women of sanguine temperament and plethoric habit, in whom a determination of blood to the uterus and its appendages is well marked by excessive and irregular menstruation; women of high sensibility who have from any cause been greatly debilitated, or who have been addicted to masturbation in early life. A liability to abortion may arise also from constitutional vices, such as syphilis, cachexy, scrofula, &c. and finally from acute and chronic diseases, malformations of the spine or pelvis, tight-lacing, &c. Anterior miscarriages are amongst the most ordinary predisposing causes.

In regard to the genital organs themselves, rigidity of the fibres of the body of the uterus, and their resistance to its gradual and natural dilatation after conception; the too great sensibility and contractility, the thinness and laxity of this organ; the atony resulting from chronic leucorrhea, and severe parturitions, may be justly ranked amongst the causes of abortion. To these may be added inordinate heat in the womb, indicative of chronic metritis, displacements, deformities, adhesions, organic degenerescences of the uterus or its appendages, the presence of two or more fœtuses, producing a too rapid dilatation, and in fine, any disease in the parietes of the womb that prevents its natural development during pregnancy, or in the organs connected with it in function, as for instance neuralgia, or rheumatism of the ovaries. They often produce abortions which recur at the same period of successive pregnancies, and these are termed periodical by some authors.

Thus fibro-cartilaginous or other morbid alterations in the parietes of the uterus, or adhesion of this organ to any of the vicinal parts, will prevent its development during pregnancy, and excite it to expel its contents prematurely. In such cases abortion generally occurs at a certain period of uterine gestation; because the uterus will not suffer distention beyond a certain extent, as its organization is so deranged as not to admit of expansion without causing irritation and uterine contractions.

It was the opinion of Peu, and many other writers, that women affected with rachitism in an extreme degree, so as to implicate the pelvis, ought not to marry. But many women with some degree of spinal deformity have no pelvic contraction, and may bring forth offspring with perfect safety. I have been consulted in numerous cases of spinal deformity, as to the safety or propriety of individuals entering into the matrimonial state; and unless where the pelvis was so deformed that cephalotomy or gastro-hysterotomy would be required at the full term of uterine gestation, have not unfrequently decided that they might. It is true, however, when the deformity of the spine is considerable, the woman is very liable to miscarriage. In those cases in which one hip is much more elevated than the other, or in which one inferior extremity is longer than the other, accompanied by more or less spinal curvature, there is generally danger of abortion or premature labour, or difficult parturition at the full term of pregnancy. Women affected with profuse leucorrhœa, or atony of the uterus, are very much predisposed to abortion.

It was observed by Juncker[1], Stolz[2], and other writers, that corpulent women very often miscarry. It is also known, that in marshy and malarious countries, under certain constitutions of the weather, abortions have become epidemic, as mentioned by Hippocrates, and as noticed at Vienna in 1788-89[3]. I might quote numerous authors who have referred to the occurrence of epidemic abortions in different seasons. Thus they were observed after the humid heat in 1696; the dry heat of the years 10 and 11 of the French Republic[4], 1802-3; the mild and windy season of 1776[5]; the intense heat of 1811[6]; the mild winter of 1816[7]; and after the rainy season of 1821[8]. These records prove the correctness of the popular opinion, that abortions are more common in certain seasons than in others. Experience has also demonstrated that women who become pregnant at a very early, or at an advanced, period of life, are more exposed to abortion, than those who become mothers between the twentieth and fortieth year. It is a medical axiom, that women who marry too early or too late in life, generally purchase the pleasures of maternity at too dear a rate. The majority of those who are mothers between the age of twelve years and a half and fifteen are not sufficiently developed to bear the inconveniences of pregnancy; their general health becomes deranged, and their parturition and puerperality are often anormal. Those who become mothers from the age of twenty-eight or thirty to forty or forty-five have the muscles and ligaments connected with the outlet of the pelvis so rigid, that they suffer most severely, and frequently lose the first infant.

When this disease is excited by rigidity of the fibres of the uterus, it recurs at later periods in successive pregnancies, because the uterus expands to a greater extent during each pregnancy: but when abortion is caused by laxity or atony of the neck of the organ, this morbid state increases in each successive pregnancy, and the abortion happens earlier.

Among the causes of abortion or premature labour may be included, violent mental emotions, passions, longings, alarm or fright, dread of thunder, explosions of artillery, impression of strong or disagreeable odours, sight of disgusting objects, errors of diet, privation of sleep, rest, or food, abuse of stimulating food or drink, over exertion in walking, riding, dancing, running, jolting of carriages, raising or carrying heavy weights, frequenting crowded and heated assemblies, ball rooms, theatres, churches, &c., falls, slips, blows or wounds on the abdomen, violent coughing or laughter, the use of emetics or drastic purgatives, frequent sexual indulgence, surgical operations, even though slight, the extraction of a tooth, irritation or pain in the genital organs, or in any part of the body.

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[1] Petiot, *Thesis at Strasburg*, 1815.
[2] Deubel, *Thesis at Strasburg*, 1834.
[3] Stoll., *Ratio Med.* t. iii., 1789.
[4] Fick in Deubel.
[5] Rogny, *Annal. Clin. de Montp.* t. ix.
[6] Nægele in Deubel.
[7] *Fischer Herfeland's Journ.* t. 47.
[8] Osiander in Deubel, and many others.

Women in the lower class of life who are exposed to much bodily fatigue and mental emotions, are also very liable to this disease. The disposition to abortion is so strong in some women, that the slightest cause, either moral or physical, will induce it; while, in others, the strongest moral or physical influences will not excite it.

Diseases of the Ovum.—The predisposing causes of abortion which depend on the fœtus, are vices of conformation, or diseases of itself, or its appendages. When these cause the death of the fœtus, it becomes a foreign body in the uterus, which sooner or later expels it. It is easy to explain this result. The uterus from the moment of conception has an afflux, or determination of blood towards it, which continues during the whole period of pregnancy; but when the fœtus dies, the congested state of the uterus is no longer relieved by the passage of the blood to the infant for its nourishment; the latter is now a foreign body; and the former, in consequence of too large a quantity of blood in its substance, becomes irritated, its fibres are thrown into contraction, parturient action succeeds, and the uterus expels the dead fœtus and its appendages.

In all cases in which the embryo or fœtus is diseased or dead, abortion, or premature labour, as the case may be, must in general ensue; the instance in which gestation is continued to the full term, being the exception.

From these observations, it may be concluded, that abortion may be produced by any cause that enfeebles the mother or fœtus; the anormal conformation and diseases of the latter, the feeble or partial adhesion of the placenta to the surface of the uterus, its implantation over the neck of this organ, its scirrhous, hydatic, aneurismal, and varicose degenerescence, its smallness in proportion to the size of the fœtus; the shortness or excessive length of the umbilical cord, its twirlings round the neck, body, or extremities of the fœtus, its augmentation of volume by sacs, hydatids, tumours, knots, or adherences in it which oppose or prevent the circulation of the blood through it; the tenuity of the membranes of the ovum, a collection of fluid between the chorion and the amnios; too small or too great a quantity of the amniotic fluid, and numerous other diseases of the ovum: these last, according to Dr. Lee, are the most frequent causes of abortion. In most abortions, from the third to the sixth month of pregnancy, the ovum is not diseased, but is expelled through the influence of some of the accidental causes already enumerated. When the ovum is normal, it adheres to, or is strongly connected with the uterus; but when it is abnormal, the slightest shock or mental emotion may cause its expulsion. It is important to examine all ova, as they often appear healthful at first, but, on closer inspection, are often found diseased before the third month. Thus on careful investigation the membranes or embryo will frequently be discovered to be anormal.

Occasional causes.—The occasional causes of abortion are various. In fact there is not a circumstance in life which may not be followed by abortion. Amongst the causes already mentioned, and which we shall not here repeat, many are also occasional; but, strictly speaking, they include mental emotions, as joy, fear, anger, jealousy, &c.; diarrhœa, dysentery, colic, tenesmus, hemorrhoids, constipation, intestinal worms, strangury; the impression of odours, as the odour of a recently extinguished candle, &c.; asphyxia, violent hysteria; coition, especially if too often repeated; riding, dancing; falls or blows on any part of the body, but especially on the loins or abdomen; violent laughing, coughing, crying, vomiting, hiccup, sea-sickness, straining in evacuating the bowels or bladder; the use of strong purgatives, emetics, emmenagogues, abortives, hot-baths, pediluvia, copious depletion, especially from the feet, the convulsive motions of the fœtus, rupture of the umbilical cord or membranes, and adhesion of the fundus uteri to vicinal organs. It is generally thought that most of these causes act by separating the placenta, but this result does not immediately occur unless this organ is of a sufficient size to acquire, by the effect of a fall, blow, or concussion, as great a motion as that which is made on the uterus. The immediate separation of the placenta is recognized by the uterine hæmorrhage which instantly or speedily follows.

It is difficult to explain placental separation effected by the causes just assigned, when we remember that the ovum exactly fills the uterus, and that the ovum is exactly filled by the fluid of the amnios. We can clearly perceive, however, that the motions impressed on the woman are almost incapable of separating the placenta from the womb, or the chorion from the amnios, which are placed like two bladders, one within the other, and the inner one filled with fluid. It has also been long remarked, that the most active, laborious, and imprudent women, those who take unrestricted exercise, generally arrive at the full term of uterine gestation; whilst a vast number, in a state of affluence and ease, abort, in spite of the greatest care and attention. It is to be recollected, that women in the lower ranks of life, who make great exertion, and who are frequently exposed to falls and blows, very seldom miscarry. Many too have received the most severe injuries without having aborted. Mauriceau mentions the case of a woman who was seven months pregnant, whose fore arm was fractured, yet she went to the full period. Madame Lachapelle relates the case of a young midwife who was pregnant, and had a narrow pelvis; she precipitated herself into a deep pit, with a view of causing abortion, and avoiding the Cæsarean operation. She died in consequence of her wounds, but did not abort. A few years since, a young woman in the fourth month of pregnancy threw herself from the fourth floor of a house in Finsbury Square, and fell on the pavement; many of her bones were fractured—she survived a few hours, but did not miscarry. Numerous examples are given in works on forensic medicine of the difficulty of inducing criminal abortion by violent means, though the destruction of the life of the woman is a common consequence of such attempts.

According to the latest physiological observations on the placenta, this organ adheres to the uterus by means of the decidua, (Velpeau, Breschet, Lee, Radford, Ramsbotham, &c.) which is directly applied over the apertures of the uterine sinuses. If the circulation of the blood is increased throughout the system, or in the uterus by means of irritation in, or determination of blood, to that organ, the consequence will be, that the increased afflux of the sanguineous fluid in the uterine sinuses will separate the decidua over them to a greater or less extent, blood will be effused between the uterus and decidua, and the placenta will be partially or wholly detached from the uterus. If the decidua be lacerated, the blood will escape, in the early months, between it and the chorion, and in the latter months, between it and the amnios, or it will lacerate the latter and pass into its cavity; or the effused blood may find its way between the uterus and decidua, arrive at the uterine orifice, and escape through the vagina. It by no means follows, however, that in every case of abortion there is necessarily a separation of the placenta at the commencement; but when this does not happen, there must be detachment of some portion of the decidual membrane from the parietes of the uterus. Compression on the uterus, or a blow, may immediately produce separation of the placenta or rupture of the umbilical cord, or of the membranes enveloping the fœtus. But, in general, the occasional causes of abortion induce congestion in the vessels of the uterus, which is often succeeded by hemorrhage from separation of the placenta or decidual membrane, which excites uterine contractions, in consequence of the inconvenience or irritation to which the organ is subjected. Thus Klein has remarked that abortion is most frequent at the return of the menstrual periods. Some of the causes already enumerated excite spasmodic contractions, which are transmitted to the uterus by sympathy, and others act upon the fœtus itself. It often happens that a vivid mental emotion of the woman, is instantaneously followed by more or less motion of the fœtus, and even by its sudden death. I have known many women, in whose statements the fullest confidence might be placed, who declared that their infants ceased to move at a certain time. It is true, however, that the infant may be born alive in some cases in which the same declaration had been made. It is generally remarked, that abortives very rarely effect the object for which they are intended, while they often destroy both mother and fœtus. Many such cases are recorded in the works on Medical Jurisprudence. "I have," says M. Désormeaux, "been consulted many times for acute and chronic metritis, severe metrorrhagia, and cancers of the uterus, which were caused by the criminal means employed to procure abortion."—*Dict. de Med.* The induction of criminal abortion is felony, and is never resorted to by respectable medical practitioners, except in cases of irreducible retroversion of the uterus, and certain diseases of this organ and the ovaries, as in these diseases the women will lose their lives, unless the uterine contents are expelled. It is, I believe, the opinion of medical practitioners in all nations, that the induction of abortion is perfectly justifiable in such cases. Dr. Ashwell's paper on the Induction of Premature Labour in cases of disease of the ovary, when rapidly advancing in consequence of the determination of blood to the uterus, may be referred to with advantage.—*Guy's Hospital Reports, No.* 2, *April*, 1836. It would, however, be better in such cases to avoid pregnancy, and that the parties should live separately.

Many authors, since the time of Aristotle, defend moderate sexual intimacy during pregnancy, among whom are Mauriceau and Dionis. "For myself," says this last writer, "I have had a wife who has been twenty times pregnant, and brought me twenty infants, of which she was happily delivered at the full period of pregnancy, and I am persuaded that the caresses of a husband are not injurious[1]." This is true as a general proposition; but I have been consulted in many cases in which abortion and premature labour were excited by frequent or excessive nuptial enjoyment. While writing this article, I was called to a case of abortion between the second and third month, induced by this cause. Every one has observed, that most of the mammiferous animals refuse copulation after conception; but physiologists admit that a moderate use of it does not appear to be injurious during human pregnancy. Aristotle even supposed that towards the end of gestation it was a means of facilitating parturition. There appears to be some reason in this remark, as I have known parturitions occur two and three weeks before the expected time, which were said to have been induced by conjugal embraces. In fine, a moderate use of this function is not injurious during pregnancy, though it should be avoided when abortion is feared or threatened.

"Pour conserver le fruit de vos chastes plaisirs,
Réprimez désormais vos amoureux désirs.
Au feu qui vit en vous un autre feu peut nuire,
Et ce qu'Amour a fait, Amour peut le détruire."
Tillet, *Dolley's Thesis*, 1826.

There are, moreover, special causes which favour the occurrence of abortion: irritative congestion of the uterus, as Désormeaux remarks, occurring at the return of the menstrual period deserves particular notice under this head. During the prevalence of cholera in Paris in 1832, abortion, from the death of the fœtus was of frequent occurrence. Habit is also not unfrequently a cause of abortion. Thus it is observed to occur at the same period of pregnancy in the same woman, ten or twenty times consecutively, without any other influence apparent in its production, than that of the *molimen hæmorrhagicum*, or debility. In these instances, the health of the woman suffers, and the prospect of a family is not unfrequently destroyed.

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[1] *Traité Général des Accouchemens, &c.*

There are some women who never arrive at the full time, and others who seem to have an hereditary tendency to abortion. It has been said, that there may be a congenital state of the uterus which prevents it from enlarging to the proper extent during pregnancy, and that the irritation produced by the fœtus will cause abortion. Schluz speaks of a lady who aborted twenty-two times at the third month[1]. Stoltz knew two women each of whom had aborted seven times[2]. I have known three similar examples. Schurigius attended a woman who aborted, or rather had a premature labour, at the eighth month after her second parturition, and did not arrive at the full term until her twelfth accouchement[3]. Burton mentions the case of a woman who had aborted eight times at the third month, and who was led by means of small bleedings to the full term with her ninth conception[4]. I have known a patient who aborted five times in fifteen months from her marriage, at the expiration of which period she died of phthisis. M. Velpeau cites many similar cases of abortion, and mentions one of a young woman who procured the expulsion of the ovum by criminal means several times, and who, after marriage, could never be brought to the natural term of utero-gestation.

Abortion is also caused by certain mechanical operations in cases of deformed pelvis, where premature labour is required, when a full-grown infant could not be born at the termination of utero-gestation. Criminal abortion is often attempted in large cities and populous towns, and generally destroys the woman by peritonitis or metritis. Cases have occurred in which sharp instruments were passed into the substance of the womb, producing fatal hysteritis and peritonitis. M. Velpeau attended a woman who had profuse hæmorrhage caused by attempts of the same kind. She suffered most excruciating pain in the pelvis for two months; abortion did not take place, but a large ulcer of the neck of the womb was produced. Girard of Lyons cites an analogous case, in which the sufferings of the unfortunate patient were so great that she committed suicide[5]. M. Velpeau states, that criminal abortion is very common in Paris, and that he had been called to four cases in two months. One woman died of peritonitis, another was affected with cancer, the third with hæmorrhage which could not be arrested, and the fourth was finally cured.

Signs of Abortion.—The phenomena of abortion will vary according to the period of pregnancy at which it occurs, and the nature of the cause which produces it. In the first two months of pregnancy, it often happens that the ovum which is of a small size is expelled entire without pain or hæmorrhage. This happens in lax habits, in whom the orifice of the womb is soft, flaccid, and very dilatable. In most cases, however, there are pains, accompanied by more or less hæmorrhage, with clots in which the ovum is enveloped and often escapes unobserved. This occurs when the membranes rupture, and the fœtus escapes detached from the placenta. In such cases, women frequently suppose they had a catamenial obstruction, and that the painful discharge is only menstrual: but the menstrual fluid does not coagulate in its normal state, unless blood is effused with it during the congested state of the uterus,—termed the menstrual molimen,—which precedes and accompanies the uterine evacuation.

In proportion as pregnancy is advanced, the size of the fœtus will be augmented, the pains and hæmorrhage which accompany abortions will be more and more considerable; and it has been long remarked, that this hæmorrhage is much more profuse, than that which accompanies natural labour at the termination of pregnancy. It is on this account that abortions are much more injurious to health than natural labours, at the full term of utero-gestation. It is also well known that a woman who has had six or eight abortions, accompanied by profuse hæmorrhage, will have much worse health than another who has had as many natural labours, at the full time. In fact, the hæmorrhage has been so great in many cases, as to destroy life, and in some recent cases, transfusion alone could preserve it. Mr. Ingleby relates a case in which six quarts of blood were lost; and Mr. Mainwright, of Liverpool, lately saved a woman by transfusion.

When abortion is produced by chronic diseases or causes that act gradually, it is generally accompanied by the following symptoms: horripilations, or rigors, succeeded by heat of skin, thirst, nausea, loss of appetite, pains in the loins, lassitude, lipothymia, palpitations, frequent pulse, coldness of the extremities, depression of spirits, sadness, pallor, tumefaction or lividity of the eyelids, loss of brilliancy of the eyes, fetidity of the breath; sense of sinking, and feebleness in the abdomen, of cold about the pubis, of weight about the vulva and anus; diminution and flaccidity of the mammæ, the nipples sometimes discharging a serosity; evacuation of a sanguineous or sanious fluid from the vagina, sometimes grumous and coagulated; decrease of the motions of the fœtus, which finally cease; sinking of the hypogastric region, or sense of coldness under the pubis; uterine pains, more or less acute and frequent; progressive dilatation of the uterine orifice, and periodical pains as in natural parturition; more or less hæmorrhage, prominence of the membranes; in fine, the expulsion of the fluid of the amnios, next of the fœtus, and lastly, after a longer or shorter period, of the placenta and membranes. The hæmorrhage seldom ceases in general before the expulsion of the placenta and membranes. As soon as the membranes rupture, the progress of pregnancy is arrested, and abortion is inevitable. Some suppose that the amniotic fluid may be discharged many weeks or even months previous to parturition, and that during labour, the membranes may present as usual, rupture, and again discharge their fluid. But such cases are examples of disease in which a greater or less quantity of fluid is secreted and accumulated between the amnios and the chorion, and finally escapes through the vagina, the amnios remaining unbroken until the time of parturition. Several pints of fluid have been collected and discharged from the uterus in such cases, while the amnios remained unbroken. It is almost universally admitted that when the amnios is ruptured, abortion, premature labour, or parturition at the full time are inevitable. I have known, on the other hand, watery discharges from the uterus in different quantities from the third to the end of the ninth month of pregnancy.

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[1] Lacroix, Thes., 1812.
[2] Deubel, Thes., 1834.
[3] Section 4. c. 1.
[4] Art of Midwifery.
[5] Journ. Gen., t. iv.

Pathology of Abortion.—When abortion follows the powerful occasional causes, it is sometimes preceded by pains and sense of weight in the loins, and sometimes in the vagina, and of general indisposition, accompanied by the symptoms already enumerated.

There is, at first, a slight serous or watery discharge from the vagina, which is speedily succeeded by a greater or less effusion of blood, or by copious hæmorrhage. In other cases there will be a profuse hæmorrhage from the commencement of the attack, until the fœtus and its appendages are expelled. This symptom generally happens in those who have suffered from previous abortions, or are plethoric or delicate. The pains may be slight or severe, and extend from the umbilicus to the uterus and vagina; parturient action supervenes, and the fœtus is expelled.

The quantity of blood discharged varies considerably: sometimes there is very little, at other times a jet, current, or several coagula, according as the separation of the ovum is more or less extensive, or as it may be more or less remote from the os uteri.

In fine, the symptoms of abortion resemble those of parturition in proportion as pregnancy is advanced. This is also the fact as regards the lochial evacuation and the secretion of milk.

In the early months of pregnancy, the embryo is often expelled, while the placenta with the membranes are retained for days or weeks afterwards. As long as the secundines continue in the uterus, there will be more or less hæmorrhage, and in some cases, this will be periodical. In all cases of abortion during the first three months, we should not take it for granted, on the statement of the patient or nurse, that the placenta has been expelled, as well as the conception, unless we have ocular demonstration of the fact. Women often mistake clots of blood for the placenta, and frequently remove them before the arrival of the surgeon. I have known cases in which the placenta was retained for three, five, and six weeks after the expulsion of the embryo; hæmorrhage was considerable, the nurse positively asserting that the after-birth had passed though it was still in the uterus.

It sometimes happens that the ovum is expelled entire, especially about the end of the second month. At a later period its volume does not allow it to be so completely detached, more especially when the pregnancy is more advanced. The entire ovum has been expelled at the fourth, fifth, and sixth months, (Diembroeck, Velpeau, Eryaud, Stoltz, Siebold, Marson, &c.) though it often happens that the placenta remains in the uterus. In the first months, the ovum may escape, covered with the amnios only, the caduca, chorion, and placenta remaining in the uterus. (Velpeau, Ricord, Guillon, Lemercier, &c.)

About the middle period of utero-gestation, the fœtus may be expelled enveloped in its membranes, with or without the placenta. Such cases are by no means of rare occurrence. It also happens in the early months of pregnancy, that the membranes may rupture, and the amniotic fluid escape; the embryo, placenta, and membranes become decomposed, and are evacuated as a brownish fetid sanies. At other times, the placenta continues attached to the uterus, increases in size, and gradually assumes a fleshy appearance, in which we occasionally find hydatids. The fœtus may be expelled, or remain in the liquor amnii, which may macerate it, and render it almost gelatinous. The degenerescence of the placenta is termed a mole. When pregnancy is somewhat advanced, the fœtus may be born alive; but if younger than the sixth month, is not viable, as it only survives for a few minutes or hours in a great majority of cases.

In some instances, the fœtus remains in the uterus until the end of pregnancy, when it is expelled in a state of *ramollissement* and maceration, without any signs of putrefaction, more especially in those cases where the membranes being unbroken, the access of the air is excluded. In some abortions, the fœtus is converted into a substance resembling adipocire, or it acquires the hardness of stone, and may remain in the uterus till the death of the mother. In others, after an indefinite lapse of time, the uterus inflames and suppurates, an abscess forms, and opens on the anterior wall of the abdomen, or into the intestines or vagina, giving issue to the pus and sanies formed by the decomposition of the flesh and organs of the fœtus, during putrefaction.

In general, however, when the fœtus is dead, it is speedily expelled from the uterus. But it has been known to remain during twenty-eight days, in the case of a woman who was seven months pregnant (Velpeau), and M. Prout informed this author of a case of a fœtus between three and four months which was retained for five months after the commencement of the abortion. When the fœtus dies at the sixth, seventh, or eighth month, which often occurs in women tainted with syphilis, it is generally expelled between the seventh and eighth month; and when it dies from other causes, it may be retained until the ninth month, and in some cases for years. In such cases, the fœtus may escape entire, or in parts. It may be expelled when blighted, while a living infant may sojourn in the uterus, and be born alive at the full term of pregnancy. The records of obstetricy contain many such examples; other cases are also mentioned in which the blighted fœtus was retained, and born with the living one.

Dr. Blundell states that when the fœtus is blighted in the early months, it may be retained until the term of pregnancy.

After the death of the fœtus, the circulation between it and the mother ceases, and the uterine hæmorrhage is seldom fatal. When the fœtus is dead, or the placenta decomposed, there will be a fetid discharge, accompanied by nervousness and more or less constitutional irritation; but these symptoms are sometimes absent. They are, however, urgent in most abortions from the first to the third month of pregnancy, and require sedatives, tonics, and nourishing diet, in addition to the local and general means recommended hereafter.

M. Ansiaux speaks of a fœtus that died at the fourth month, and was not expelled until the end of pregnancy[1]. Ozanam described a fœtus converted into an irregular mass which weighed six pounds[2]. Huzard has observed the same in ewes, and Carus established that the fœtus may be absorbed, decomposed, or covered with a calcareous crust[3]. He mentions a woman who was in irregular labour in 1814, and was still pregnant in 1820. The fœtus remained fifty years in the uterus of another of his patients[4]. Lieutaud relates several examples of the fœtus having remained in the womb for twenty, thirty, and forty years. Recent writers have mentioned cases of retention of the fœtus for a shorter period. M. Velpeau saw a woman in April, 1834, with M. Vasseur, whose fœtus had remained since the autumn of 1833 without any serious inconvenience, and he observed another with MM. Puzin and Moreau in which the woman died at the end of the third month, and the fœtus was unaltered. Barbaut describes the case of a fœtus which died about the fourth month, and was not expelled before the eighth[5], and another which died at the same age, and was not thrown off until the ninth month. In both cases the membranes were thick and tough, and contained but little fluid.

Cases of early abortion of the second and third month have fallen under my own observation, in which the placenta was retained from one to twelve weeks after the expulsion of the fœtus, and without having been much altered. It is also said that the membranes may be developed, and that the decidua may become thickened. In such cases, the amnios is said to disappear, the cavity of the chorion becomes gradually thickened, and assumes the form of a solid fleshy mass, in the centre of which is a cavity generally containing a serous fluid. The placenta may continue to increase, or may be infiltrated; and when expelled, it may possess none of its primitive characters.

The alterations of the ovum, according to M. Velpeau and Dr. Granville, are numerous and cannot be easily discovered. They usually form moles, and their appearances are so diversified that it would occupy a large volume to describe them.

MM. Velpeau and Breschet have also given illustrations of multiform abortions in their respective works on human ovology. I may observe, that in my opinion, the different products elucidated in the first ten plates of Dr. Granville's work were evidently morbid; the same has been stated lately respecting those of M. Velpeau, before the Academy of Sciences by M. Coste and Dr. Alexander Thomson. (*Gazette Médicale*, *Journ. Hebd.*, *&c.*, *Oct.* 1835.)

It often happens that the fœtus and its appendages are expelled entire. I have known examples at every period of utero-gestation, from the first to the sixth month, and the same thing occurs from the sixth to the ninth month.

The expulsion of the entire ovum occurs most frequently at the end of the second month. M. Velpeau has observed one case in which the fœtus was expelled covered with the membranes at the sixth; and I have also met with a similar example. Diembroeck is of opinion that it may occur at the full period of utero-gestation, and I have been informed of two examples. (*Anat. du Corps Hum.*, t. i.) Baron Larrey sent M. Velpeau a fœtus thus enveloped at the fifth month and a half; and M. Eryaud reports a similar one. (*Thesis, Paris*, 1831.) M. Stoltz has seen a case at five months. (*Deubel. Thesis at Strasburg. April*, 1834.) Marson has met with an example at the eighth month. (*Deubel, op. cit.*) MM. Velpeau and Ricord have seen several in the first months of pregnancy, in which the ova were expelled covered by the amnios alone. (*Traité Complet d'Accouchemens, &c.*, 1835.) It generally happens, however, in the early months of pregnancy, that the ovum is expelled covered with the membranes, but the placenta remains behind and gives rise to tedious and sometimes fatal hæmorrhage. In some of these cases, transfusion alone can preserve life. I may here remark, that the great difficulty in treating abortions during the first six months of pregnancy arises from the impracticability of any manual operation, for the removal of the placenta. In such cases, the secale cornutum will often excite the uterus and cause it to expel the placenta. If this medicine fail, the vagina ought to be plugged tightly, and by this means the hæmorrhage will be arrested. When there is great prostration of the vital powers, nutritious aliment and cordials will be necessary. Mr. Ingleby relates three cases of abortion at the second month, and one at the fourth month, in which the hæmorrhage proved fatal. In one of the three, the patient died before any part of the ovum was expelled from the uterus. Another died from hæmorrhage at the seventh day after the expulsion of the ovum. In the case at the fourth month, the fœtus was expelled, but the placenta did not separate. He correctly remarks, that such fatal results are unusual at those early periods. (*Treatise on Uterine Hæmorrhage*, 1832.) A lady of title died lately of hæmorrhage in the early months.

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[1] Clin. Chir., 1829.

[2] Compte rendu des hospitaux de Lyons, 1823.

[3] Zur Lehre von Schwangerschaft und Geburt Phys., Leipzig, 1822.

[4] Bull. de la Faculté.

[5] Cours d'Accouchemens, &c.

Prognosis of Abortion.—Hippocrates observed that abortion, or premature labour, was more dangerous than natural parturition. The first is a disease, the second the performance of a natural function. It does not, however, always follow, that abortions are dangerous. Much will depend upon the period at which they occur, on the causes which produce them, and on the symptoms and diseases which accompany them. As a general proposition, it may be stated, that the earlier the abortion, the greater the danger to the woman, more especially between the second and fifth month of pregnancy, the hæmorrhage is more abundant, and the fœtus and its appendages are expelled with more difficulty than from the fifth to the end of the ninth month. In the former cases, the uterus is not sufficiently developed to admit the introduction of the hand to extract the placenta. Nevertheless, there are some eminent obstetricians who maintain, that the danger is greatest in proportion as the pregnancy is more advanced. (Désormeau, *Dict. de Med.*, Art. Avortement. Velpeau, *Traité Complet d'Acch.* Copland, *Dictionary of Practical Medicine, &c.*) It is also a received opinion, that abortion produced by accidental causes, is more dangerous than when it is effected by predisposing causes, and especially when the cause acts with violence and suddenness on a woman who is not predisposed. Again, abortion is most dangerous when provoked by medicines or mechanical means. In such cases, the woman is generally destroyed by hæmorrhage, metritis, enteritis, or peritonitis. When abortion occurs spontaneously, and without any evident cause, or from diseases of the ovum, it is accomplished with little pain or difficulty, and may not be followed by any unfavourable symptoms; but it is very liable to recur; and frequent recurrences are succeeded by numerous diseases, such as deranged menstruation, chronic metritis, organic diseases of the uterus, leucorrhœa, hysteria, dyspepsia, cachexia, phthisis, and lesions of organs already predisposed to disease. The chief sources of danger, however, in connexion with abortion, are the hæmorrhage that accompanies it, the prostration of strength which follows it, and the diseases which are excited in predisposed organs. When abortion is accompanied by convulsions, or when it occurs during the progress of fever, small-pox, scarlatina, measles, erysipelas, or visceral inflammation, the prognosis is very unfavourable; and the woman frequently dies. When it is excited by mechanical means, it may be succeeded by inflammation of the uterus, which will endanger the life of the woman, or cause adhesions between the parietes of the uterus and the fimbriated extremities of the uterine tubes, and thus induce incurable sterility; or gangrene may ensue, and cause death. A few years since, a healthy young woman, in the third month of pregnancy, had a tumour removed from her breast in St. Bartholomew's Hospital. She aborted immediately after the operation, and died on the following day of peritonitis. It has long been received as an axiom in obstetrics, that surgical operations ought not to be performed during pregnancy or lactation, unless for some disease which threatens the immediate destruction of life.

When the neck of the uterus is soft and relaxed, while the rest of the organ preserves its normal density, abortion takes place more readily, and with less danger than in the contrary condition of the parts. If it is produced by a well-marked *molimen*, and without any morbid complications, it may terminate as favourably as natural parturition; but it is to be remembered that this hæmorrhagic effort is often the first stage of inflammation, and when attended with fever, we have to fear metritis or peritonitis: if they should arise, the prognosis, as already stated, is very unfavourable.

Some authors (James and Mauriceau) consider abortion beneficial to health, by establishing the regularity of menstruation, and inducing fecundity. Hippocrates himself was of opinion, that if it occurred sixty days after conception in a woman whose menstruation had been usually deranged, the evacuation would become regular. Mauriceau stated, that women who had been sterile for many years, in consequence of suppressed menstruation, became fecund after abortion. But the occurrence of abortion in such a case was positive proof that the woman was not sterile. There is, perhaps, but one case in which abortion is favourable to reproduction; and that is, when the cavity of the uterus is too small, and the tissue of the organ too dense, to allow sufficient dilatation of the former, for the developement of the ovum. In such a case, the first abortion would diminish the anormal rigidity; the second, third, or fourth, would expand the organ more and more, or completely overcome its resistance, and at length natural parturition would be effected.

Treatment.—The indications of treatment are to prevent abortion; and when that cannot be accomplished, to combat the unfavourable symptoms which accompany it, and to obviate the accidents that may succeed it. The preventive treatment embraces the following indications:—to remove the predisposing causes; to repress morbid action; and to avert the occasional causes.

The principal predisposing causes are errors relative to the rules of hygiene; the influence of temperament; plethora; disposition to hæmorrhage, and excessive menstruation; hereditary disposition; organic diseases of the uterus; and implantation of the placenta over the neck of the organ, which cannot be prevented by any plan of treatment; to which may be added, the diseases of the ovum and its appendages.

When there is excess of rigidity of the uterine fibres, or of contractility or sensibility of the whole organ, refrigerant drinks, venesection, warm baths, and emollient vaginal injections, with anodynes, are required. In the opposite conditions of the uterus, when there is feebleness and laxity of the fibres of its neck, and atony of the organ; tonics, nutritive aliment, cold bathing, either simple or saline, and astringent vaginal injections are indicated. The best time for treating both states of the uterus is during the intervals between the pregnancies.

When abortion is threatened in consequence of uterine congestion, tranquillity of mind and quietude of body ought also to be strictly enjoined. The apartment should be large, cheerful, and airy; the bed clothes light; bed curtains and fire should be removed in warm weather; the diet ought to be light, nutritious, and digestible, consisting of the vegetable jellies, such as arrow root, sago, &c.; the drink should be cool, as lemonade, barley water, imperial, toast water, &c.

This plan ought to be persevered in by those who have had former abortions, for several days, as the slightest deviation from it will induce the disease with which they are threatened.

There is much diversity of opinion as to the use of aperients in threatened abortion. Denman, Croft, and others, preferred allowing the bowels to be confined for two or three days; they considered that laxatives, by exciting them, would also irritate the uterus, and increase the danger of abortion. I have long followed this rule in practice. I have first tranquillized the uterine pains with sedatives; and when they had ceased, administered castor oil with fifteen or twenty drops of the sedative or common tincture of opium. Indeed, the lancet or opium employed as soon as possible, with rest, and the remedies already enumerated, will in most cases prevent abortion. I have generally found the opium succeed; and I should not defer giving it until bed-time, as recommended by a late writer.

When the contractions of the uterus are spasmodic or convulsive; antispasmodics, sedatives, warm baths, and fomentations, generally afford relief.

The treatment of abortion may be divided into preventive, palliative, and active.

The preventive treatment must vary according to the exciting causes, which are to be combated or removed.

In full habits, blood-letting, in small and repeated quantities, is one of the best means of preventing abortion; Dionis advised it to be performed eight days before the second menstrual period[1]. It was the principal remedy employed during the epidemic abortions which prevailed at Vienna in 1778-9[2]. But it would be wrong to conclude with the vulgar, that venesection is necessary in all cases of pregnancy, and in all abortions. Obstetric writers advise it in threatened abortions, when women are robust and plethoric, but all condemn it when the constitution is enfeebled or delicate. In the latter cases, nutritious aliment and tonic medicines, such as cinchona, quinine, rhatany, &c. with a liberal use of wine, especially claret, and cold bathing, are recommended by Dr. Denman and others. Plethoric women often abort several successive times, between the second and third month of pregnancy; but they may be conducted to the full term of gestation by repeated venesection at the recurrence of the menstrual periods, absolute rest, opiates, cold hip bath, or sponging the lower part of the abdomen, hips, and thighs, with vinegar, and cold water, and cold vaginal injections are sometimes beneficial. In most cases of threatened abortion, absolute repose on a mattrass or couch, and the exhibition of a full dose of morphia, or the sedative solution of opium, to allay uterine action, will prevent it. But when there is no hope of prevention, the degree of pain indicating the degree of action of the uterus, and such action favouring and producing the contractile power of the blood-vessels, the employment of opiates is contra-indicated, as it would tend to continue the hæmorrhage. It is scarcely necessary to observe, that the erect position, standing or walking, &c. cause the descent of the uterus in the pelvis, excite its action, and provoke abortion or premature labour. Opiates are also proper at the recurrence of the menstrual periods in irritable, nervous women, and when there is disorder or irritation in the bladder or rectum. Mr. Ingleby relates some instructive cases, in which he prevented abortion by the use of opiate suppositories. In one case the patient had aborted eight successive times; and in another, where premature labour was threatened, at the sixth month, he employed a scruple of opium in grain doses, and succeeded in conducting the pregnancy to its termination. He also strongly insists on the necessity of conjugal separation during the first five months of utero-gestation. This last opinion is also judicious in all cases of threatened abortion; and the non-observance of it is a frequent cause of this accident, as I have already stated. Hæmorrhage must be arrested as speedily as possible, as it weakens the woman, diminishes uterine energy, often destroys the fœtus, and frequently ends in abortion. This is effected by the contraction of the coats of the blood-vessels, or by the formation of coagula. Syncope, which often alarms unnecessarily, arrests the rapidity of the circulation, and favours the formation of coagula. Dr. Denman observes, on this point—"Cordials are not, therefore, to be hastily given to those who faint from loss of blood; unless the faintness should continue so long as to make us apprehensive for the immediate safety of the patient[1]." It is important to remember that, in abortion, there is a separation of the decidua, or chorion, from the uterus, and an effusion of blood, of greater or less extent, between the separated parts, or between the chorion and amnios, or into the cavity of the amnios. The separation between the decidua and uterus is perhaps most frequent near the neck of the organ, on account of its dependent position; but it may occur at any part of the uterine cavity. (Boudeloque[2].) If the blood escapes from any part of the superior portion of the uterine cavity, it cannot readily pass through the orifice of the uterus; it acts as a foreign body, excites irritation and contraction of the womb, by which it is finally expelled.

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[1] *Traité des Accouchemens.*

[2] *Stoll. Rat. Med.*

Astringent medicines, and those which diminish the action of the heart, such as digitalis, colchicum, tartarized antimony, hydrocyanic acid, &c., are administered with a view to arrest uterine hæmorrhage. Remedies of the latter class are, however, of doubtful efficacy in cases of abortion. Digitalis has been recommended in drachm doses by high authority, but I believe it is seldom, if ever, prescribed at present in such quantities. Astringents are, in general, preferred after venesection, and the infusion of roses, with an additional quantity of sulphuric acid, is an old remedy, very much employed by a great number of practitioners, but, according to my experience, it is a very inefficient or rather useless medicine. I agree with Dr. Blundell, "it is an excellent remedy when the battle is won." The same remark applies to catechu, kino, sulphate of alumen, &c. I cannot agree, however, with Dr. Denman, that astringents "have no power in stopping hæmorrhages from the uterus[3]." I have repeatedly observed the greatest success follow the employment of the acetate of lead, dilute acetic acid, and the sedative solution of opium, with distilled water; but in much larger doses than those advised in works on materia medica. (℞ Plumbi acetatis gr. vi—xx; Acidi acetici dil. ʒi—ij; Aquæ destillatæ ℥iij—ij; Liq. opii sedativi ʒss—ʒj; Syrupi simplicis ℥j. M. Dosis sem-uncia singulis, secundis, vel tertiis horis.) When this medicine is rejected by the stomach, Dr. Dewees orders it to be injected into the rectum, in the proportion of twenty grains, with a drachm of laudanum, and three ounces of water.—*American Cyclopædia.* The dilute sulphuric acid, combined with digitalis and colchicum, is often highly useful. I have also repeatedly found nauseating doses of tartarized antimony arrest hæmorrhage, when all other means had failed. The tinct. ferri muriatis is also a powerful astringent, and may be employed in the absence of uterine congestion. The powder of secale cornutum with an aromatic, in doses of three grains, every second or third hour, is a remedy capable of arresting uterine hæmorrhage, when slight, and also menorrhagia and leucorrhœa. Tannin, in the dose of a grain or two, in a pill, in the second hour, is strongly advised by some foreign authors.

In addition to all the means mentioned in the preceding remarks, the tampon, or plug, is a most efficient auxiliary. Notwithstanding the strong recommendations of the French, German, Italian, and American obstetricians, I regret to state that it is too seldom applied in Great Britain and Ireland, even at the present period. It is a remarkable circumstance, that a remedy advised by Hippocrates, Moschion, Paulus Ægineta, Hoffman, Leroux, Désormeaux, Lachapelle, Capuron, Gardien, Velpeau, and many others on the continent of Europe; and in this country, by Smellie, Denman, Hamilton, Burns, Ingleby, and many others; and by Dewees and the American obstetricians,—is by no means so generally employed as it ought to be in the British dominions. The use of the tampon or plug is, however, highly beneficial in abortion. The scientific reader is aware that the uterus, in the second, third, and fourth months of gravidity, is firm and undilatable in its tissue, and comparatively small in its cavity; and that it offers unconquerable resistance to sudden dilatation at these periods of pregnancy. It therefore follows, that when pressure is made on the uterine orifice, by means of the tampon or plug, of lint, charpie, muslin, or other soft material, and the vagina firmly plugged, very little blood can be effused into the comparatively small cavity of the uterus, from the second to the fourth or fifth month of pregnancy. But the dilatability of the uterus is considerably increased after the fifth or sixth month of pregnancy, and still the plug may be employed, though the hæmorrhage will be more profuse. It need scarcely be observed, that from the seventh to the ninth month, the dilatability of the womb is so great, and its cavity so large, that the remedy under consideration is of doubtful efficacy, and, in my opinion, ought not to be employed, as it may prevent the escape of blood externally, which may accumulate in the uterus to a dangerous or fatal extent. As a general proposition, I think it may be maintained, with Leroux, that the tampon or plug is a most valuable remedy during the first five months of pregnancy. The mode of applying it is as follows :—The obstetrician moistens several small pieces of lint, calico, muslin, charpie, old silk handkerchief, or some other soft cloth, with vinegar and water, or a weak solution of alumen ; he then squeezes, and oils them, and introduces them one by one against the os uteri. He continues to introduce them until the vagina is impacted, and pressure made against the orifice of the womb, which prevents the escape of blood, favours coagulation, and stops the hæmorrhage. It is essential to fill the vagina completely, for if the plug be loose or too small, the hæmorrhage will continue. It also often happens, that the vagina, in those who have had offspring, dilates in a few hours after the introduction of the plug, and the hæmorrhage returns. In such cases an additional quantity of lint, or soft cloth, ought to be introduced. When the urethra is firmly compressed, there may be retention of urine, and it will be necessary to remove one or more of the last pieces of lint that have been applied, which can be easily effected by the surgeon or the patient, without disturbing the rest of the plug, or the coagula formed between it and the orifice of the womb.

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[1] *Denman's Obstetrician's Vademecum, &c., edited by M. Ryan,* M.D., 1835.

[2] *Traité des Hémorrhagies Utérines, &c.,* 1834.

[3] Obstetrician's Vademecum, 1835, p. 158.

It is not easy to determine the exact quantity of lint which is required to plug the vagina, which varies in dimensions, and is very dilatable, especially in married women. The rule is to fill it completely ; and, should it dilate, and the plug become loosened, to introduce an additional quantity of lint. In some cases, the constrictor vaginæ closes the external genital fissure, though the vagina is very capacious behind this part, and renders it difficult to use the plug. In such cases, the practitioner ought to persevere until he has accomplished the object he has in view. I have met with examples of this kind, in which an hour was employed in applying the plug efficiently. In these instances, and when the vagina is narrow and undilatable, as in women who have not borne offspring, it will be difficult, and often impracticable, to introduce a large piece of cloth, or of sponge, as advised by some writers. The sponge will rarely make sufficient pressure against the uterine orifice to arrest the hæmorrhage, and is often removed with difficulty. It is scarcely necessary to observe, that it ought to be wetted, oiled, and firmly compressed on being introduced into the vagina. In some cases, three or four large pieces will be required to fill the vagina, and make sufficient pressure on the os uteri. The majority of women have a great objection to the operation, and, under such circumstance, its real object ought to be explained ; as also the fact, that the substance about to be introduced, cannot pass into the womb, bladder, or bowel ; in fine, that it is only to be placed in the passage through which the infant comes into the world.

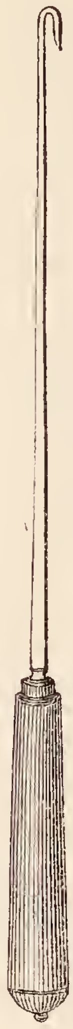
The next point of practice relates to the time at which the plug ought to be removed. This must be determined according to the circumstances of the case. Dr. Dewees advises its removal at the expiration of twelve or fourteen hours ; and others extend the time to twenty-four hours. The first period is, in my opinion, too short in many cases, and the second too long in many others. When the hæmorrrhage has been profuse, and is followed by prostration of strength, there may be great danger of its recurring, on the removal of the tampon. The judgment of the practitioner alone will enable him to act according to the circumstances of the case. I am disposed to conclude, from my own experience, that the plug may be removed in most cases at the expiration of twelve hours in summer, and of twenty-four in winter. It is to be borne in mind that decomposition of blood, membranes, &c. rapidly takes place in the vagina, on account of the heat and moisture of that canal ; and when this commences, the coagula and clothes will become sources of irritation. I have frequently observed that, on removing the plug at the termination of twelve or twenty-four hours, the vaginal discharge was characterized by a putrid fetid odour ; there was great tenderness of the vagina, and frequently an intolerance of the plug.

In such cases, the employment of anodyne injections, composed of the solution of the chloruret of lime, the liquor plumbi acetatis, water, and opium, and sometimes of the compound solution of alumen, of our pharmacopœia alone, or properly diluted, are of great service. These ought to be employed by means of a double syringe. As a general rule, the tampon and injections should be renewed as long as hæmorrhage continues.

But in some cases the former excites the contraction of the uterus, the detachment of the ovum and its appendages, and these are expelled on its removal. This event is favourable when the preventives of abortion have failed ; and there is another advantage, that the vital powers are not allowed to be reduced by slow, tedious, or profuse hæmorrhage.

Cold astringent and iced waters are sometimes injected into the vagina or the rectum, but these are rarely borne, and are now seldom employed in this country. Cold lotions and ice are sometimes applied to the hypogastric region. Nurses employ vinegar and water, over the inferior part of the abdomen, as an astringent ; and it sometimes happens that the hæmorrhage ceases, when the effect is ascribed to the applications. Cold acidulous drinks are generally prescribed by obstetricians.

When the orifice of the uterus is dilated, and the uterine action is energetic, after the preceding remedies have been judiciously employed, abortion, or premature labour, as the case may be, is inevitable. In such cases it has been proposed to rupture the membranes with the finger, a probe, a stilet, a piece of wire, &c. for the purpose of allowing the amniotic fluid to escape, which will excite the uterus to expel its contents. This operation is successful in many cases; but the ergot of rye ought to be exhibited after its performance. It is maintained by many celebrated obstetricians, that rupturing the membranes is bad practice before the sixth month of uterine gestation, as threatened abortions before this period are generally prevented by the means already described, and the hæmorrhage is more alarming than dangerous. The last part of this statement is true in general, but it is liable to exceptions. Most practical obstetricians, I apprehend, have met with fatal cases of hæmorrhage caused by abortion or premature labour. It is a popular and erroneous opinion, among women of all classes, that abortion is a trifling occurrence, unworthy of notice, or of medical treatment, and rarely, if ever, fatal. The universal experience of medical practitioners attests the contrary. It rarely happens that the ovum is entirely expelled during the first three months of pregnancy; the uterus appears to be most reluctant in parting with its contents, as nature has not intended that it should, and though the embryo or fœtus may be expelled, the placenta and membranes are generally retained, and give rise to hæmorrhage, which may continue for an indefinite time, until the cause is removed. In such cases we ought to administer the ergot of rye, and, should this fail, to plug the vagina, and use injections in the manner before mentioned. The strength of the woman ought to be supported at the same time, by tonics and nutritious aliment. When the placenta and membranes are retained, the obstetrician ought to examine the os uteri, when he removes the plug, and if he feels the placenta or membranes, to hook them down with the finger, if possible. When this cannot be effected, Levret, Leroux, Burton, Dewees, Blundell, and others, recommend the introduction of a small wire forceps, a practice justly censured in strong terms by Puzos, and now generally discarded. It would be feasible when the placenta was detached, and lodged in the neck of the womb, or tangible by the finger, but when it is recollected that this organ may be attached to any part of the uterine surface, it is obvious, that the random introduction of a forceps to seize it, without the possibility of knowing its situation, would be highly dangerous, as the operator might, much more readily, lay hold of the uterus than the placenta, and lacerate it. I entirely agree with Professor Burns, that when the pregnancy has not advanced beyond the fourth, I should say the sixth, month, it would be better to trust to smart clysters and the plug. A pair of dressing forceps, as long, but more slender, than those used in lithotomy, will often enable us to extract the placenta or membranes, when lodged in the orifice of the womb, but I should hesitate to introduce it into the cavity of the uterus, for the reason already assigned.



Dr. Dewees advises a small crotchet, which consists of a piece of steel, as thick as a small quill, fixed in a handle, and with a curved extremity. (See accompanying figure, which represents the instrument one-third the natural size.) He passes this into the uterus when the placenta or involucra are felt with the finger but cannot be extracted; and also in those cases in which a portion of the membranes remains in the cervix or os uteri, which prevents the contraction necessary to stop farther bleeding. When introduced into the uterus, he twists the extremity of the instrument so as to entangle it in the placenta or membranes. In every case in which he has used it, the discharge has instantly ceased [1].

It has been proposed to introduce the hand into the uterus, before the sixth month of pregnancy, for the purpose of extracting the placenta and membranes; but every one who has observed the size of the uterus at this period, must conclude, that the passage of the hand through its orifice, would, in almost all cases, be a most dangerous, if practicable, operation, and would most probably lacerate the organ, and excite fatal inflammation.

It is certainly within the range of possibility that the uterus may be sufficiently developed at the sixth month of pregnancy to admit the introduction of a small hand; but granting such a case, it would only be an exception to the general condition of the organ. The proceeding is, however, now the less necessary, as the ergot of rye will, in most cases, effect the desired object. Dr. Denman has expressed himself clearly upon this point: "The ovum has sometimes been retained in the uterus for many months after the symptoms of abortion had appeared, and when it had lost the principle of increasing. But it is not now thought necessary or proper in abortions to use any means for bringing away the ovum, or any portion of it, *with instruments or manual assistance*."

When abortion cannot be prevented at the sixth or between that period and the seventh month, it is to be treated as natural parturition. In such cases there is rupture of the membranes, discharge of the amniotic fluid, expulsion of the fœtus and of the placenta, which occur in regular succession. The placenta and membranes are rarely retained after the birth of the fœtus; but should it be so, the administration of the ergot of rye will seldom fail to excite uterine action sufficient to cause their expulsion. It is an error to suppose that this medicine cannot act on the uterus before parturition has commenced; I am certain that it acts on the uterus at any period after conception, and even on the unimpregnated condition of the organ. I have found it in numerous cases an efficient emmenagogue; and consider it irreconcileable to science to suppose that any medicine can only act on an organ when it is performing a part of its function, but not at any other time.

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[1] American Cyclopædia of Practical Medicine and Surgery.

The treatment of women after abortion must vary according to the symptoms of the case. When there is prostration of the vital powers, or great debility, the use of stimulants, tonics, and invigorating aliment, will be necessary. The health is often shattered and ruined by repeated abortions, and must be restored when possible by appropriate means. Warm rooms, tight lacing, late hours, and all debilitating causes are to be avoided. When the abortion occurs between the fourth and sixth month, or when premature labour comes on from the seventh to the ninth month, the same treatment ought to be employed as after natural parturition.

When abortion is habitual, it is difficult to prevent it by any means that may be employed. The following plan will in general succeed, if regularly pursued:—

I°. As soon as conception has occurred, the patient ought to be confined to a sofa, or to bed, in which she should remain until the usual period at which she aborted before, is passed.

II°. Leeches ought to be applied to the hypogastric region, groins, or external labia, a few days before the recurrence of each menstrual period; or small bleedings may be had recourse to instead. The venesection, or sanguisuction, and opiates should be repeated before each menstrual period, until the pregnancy has advanced a month or two beyond the former period of abortion.

III°. Aperients are necessary to regulate the bowels, but all drastic medicines ought to be avoided. The combination described below [1], followed by seidlitz, soda, or lemonade powders, castor oil, or magnesia, with a small quantity of lemon juice, are highly useful. It acts efficiently without causing any tormina, or exciting the uterus.

IV°. The diet ought to consist of vegetable jellies, such as arrow-root, sago, tapioca, Iceland or Irish moss, &c.

V°. Conjugal intercourse ought to be strictly prohibited.

I have employed this plan of treatment from the third to the eighth month, in the case of a lady of rank, who had had seven abortions between the third and fifth months of former pregnancies. She arrived at the full term, and brought forth an heir, who secured the estates and title which would have otherwise passed into the possession of a different branch of the family. Dr. Dewees, Dr. Jackson, and others have applied blisters to the sacrum and abdomen in such cases, with a view of exciting counter-irritation, and preventing uterine action; but the former has not employed them for some years past. Tonics, chalybeates, mineral waters, change of air, sea-bathing, or cold bathing, are highly beneficial, during or after the convalescence of abortion in delicate, nervous, and irritable habits, predisposed to the disease. Stimulating liniments alone, or mixed with tonics, may be rubbed on the loins and hypogastric region, and are much praised by recent authors. These means ought to be employed between the conceptions, and a conjugal separation ought to be observed after abortion, as pregnancy very speedily occurs to women liable to this disease.

The debility caused by abortion is accompanied by great pallidity, or a tendency to anæmia for which the preparations of iron are highly advantageous. I have given the carbonate of iron with aromatic powder in many cases with the best effects. The other preparations of this medicine are also valuable. Tonics, quinine, the chalybeate mineral waters, nutritious aliment, pure air, and other restorative means are highly necessary.

(*M. Ryan.*)

ABRASION, from *abrado*, to shave off. The mechanical removal of the epidermis, whether from the violent friction of machinery, or from slow but continued rubbing, by which the cellular tissue is exposed; in vulgar language, the denuded parts are said to be "*raw.*" Occurring on the mucous surfaces, abrasion is a superficial excoriation, from which membraniform shreds are detached. The mucous membrane of the urethra is said to be abraded when violence is done to it by awkwardness in sounding, or by the immethodical application of caustic.

ABSCESS. *Abscessus*, derived from the verb *abscedere*, to depart, or separate from. The word is known in medical language, since the time of Celsus, and is applied to every species of accumulation of pus, that obtains, in the various structures of the body. Pathologists are not agreed, whether the term has arisen in virtue of the anormal separation, which the accumulating pus produces, of the organic layers, or laminæ, in which it is deposited, or of the vital phenomena, by which, the new fluid is separated from the blood. The word is not employed to denote purulent collections within the natural cavities of the pleuræ and peritoneum; such collection, being designated by the term "Effusion," will be considered hereafter. Strictly speaking, therefore, an abscess may be defined, a collection of pus, in an accidental, or preternatural cavity. An abscess is never a primitive affection, but is itself, always the consequence, or the termination of some inflammation, either manifest or obscure, which has preceded it, in some of the living tissues. Pus, like the substance of false membranes, bands of adhesion, and other pathological productions, has its origin in all cases, in inflammation, in some shape or degree. The opinion maintained by Dehaen, and his followers, that pus was perfectly formed in the blood, and circulating with it, could be deposited in our organs, without previous inflammation, is now no longer adhered to, by any physiologist. Modern researches have led to a more correct view, and explanation of the circumstances, which our predecessors alleged in favour, of abscess by metastasis; for let it be granted to the fullest extent, that an abscess, fully formed, may suddenly disappear, and that another may as suddenly be formed in a different part of the body, we still have other means more in accordance with the laws of physiology, to account clearly for the phenomena. It is not necessary to suppose a veritable migration of the pus for such a purpose, when the displacement of the irritation affords a more rational explanation of them. Inflammation being the only cause of abscess, the pus is absorbed, and disappears under the agency, of the eliminating powers, and new pus is formed, where the new inflammation has manifested itself. There is, however, a class of purulent formations which have been brought under closer observation of late years, and which have been treated under the head of "Metastatic abscesses," to which we shall advert in another place. (See Purulent Depôts.) The origin of all abscesses, in inflammation of some kind or degree, may therefore be taken, as a general or common character; in almost every other respect their differences are infinite. Thus they differ in the shades of inflammation, which precede their formation, in the parts in which they are formed, in their progress, in their extent, number, and position with respect to the internal or external surfaces of the body, and to the qualities of the fluids they contain.

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[1] ℞ Extracti colocynth. comp. ℈ij; extracti hyoscyami ℈j; hydrargyri submur. ℈ss; olei menthæ piper, ♏. V.

In pilulas xij. vel xv. divide, quarum sumatur una mane nocteque si opus sit.

Pathological writers have availed themselves of some of these leading differences, to establish divisions, for the methodical consideration of the entire subject. Thus, from the conditions in which the inflammation has arisen, from its degrees of intensity or moderateness, from the greater or lesser rapidity of its march, has been established, the well known division into *acute* or *hot inflammatory abscess*, and *cold* or *chronic abscess*. The more modern, and more severe pathologists reject this division, as improper, and inapplicable to tumours, differing in their nature, and depending on different vital lesions. They regard all purulent tumours, as having the same origin; namely, inflammation, and think, that the chief object of the practical surgeon should be, to study the modifications they present, according to the intensity of the inflammation that produces them, the nature of the organs in which they are developed, or according as the accumulation of the pus takes place in the tissue in which it was first formed, or as it may, by making way through the cellular membrane, present itself in a depending and distant situation.

Having admitted inflammation to be the invariable origin of abscess, the different phenomena which succeed each other, from the invasion of the inflammation, to the perfect formation of the pus, should now be passed in review. The afflux of blood in the inflamed parts increases in the ratio of the violence of the irritation, of which they are the seat. The distension proceeds gradually, till some of the vessels give way, and the blood is shed around into the substance of the organs, which thus becoming more compact and heavy, lose their elasticity. When this state of engorgement is allowed to go on unchecked, the parts lose their natural power of resistance, and are broken down easily; they become disorganized, and together with the blood, with which they are loaded, are softened into a pulpy mass, which gradually dissolves into a sanio-purulent fluid. This fluid, however, is not formed solely from the blood, which in the progress of the inflammation had distended and ruptured its vessels; it consists also of the debris, or destroyed portions of the solid tissues, with which it combined. These elements are still distinctly discernible in the fluid, which flows from abscesses, that are opened, before they are allowed to maturate, as in furunculus, and even in some abscesses that have come to full maturity; as for instance, in suppuration of the liver, the matter is almost invariably of a reddish brown colour, and often contains portions of the disorganized viscus, which give it a grumulous appearance, like the lees of wine, or coffee grounds. The pus, however, in the early stage of the suppuration, is not collected into one general cavity; before this occurs, many small focuses, previously formed, and perfectly distinct, must be broken up, by the gradual disruption of the cellular, or organic walls, within which they were primitively confined; many of these separations, however, even in very large abscesses, after undergoing attenuation to a considerable extent, remain as bands and threads, which exist unbroken, in the abnormal cavity. They are broken down successively, as the suppurative action is extended, and disappear entirely, when the cavity becomes very large; but as long as they exist, they tend to check the extension of the suppurative action, and when it is terminated, they help to draw the sides of the cavity together, and to form the foundation, for healthy adhesions of its walls. Blood-vessels of a certain size, and nerves, when they happen to be placed, in the midst of the focus, resist this breaking down, and preserve their normal communications in the bosom of the abscess, between the parts which the pus has separated; while the walls of the cavity are being thus extended, by successive additions of small isolated neighbouring focuses of pus, the pus itself becomes more and more perfectly elaborated; the last traces of the colouring matter of the blood disappear, the broken down organic debris fall to its sides and adhere to them, the pus becomes more homogeneous, and finally forms a fluid, *sui generis*, endowed with properties differing from those, of all other animal fluids.

But it must not be inferred from this description, that the accidental isolating membrane of an abscess, is nothing more, than condensed cellular tissue. Sometimes, the isolating sac is formed without cellular tissue, as in abscesses of the brain ; in most cases, however, it is formed by the surrounding condensed cellular tissue, together with, organized matter, which is effused during the suppurative process.

The pus of an acute abscess, is in general cream-coloured, or whitish, homogeneous, soft to the touch ; it is heavier than water, in which it is partly dissolved ; it is free from unpleasant smell, and as long as, the air is excluded, it exerts no irritative action, beyond that of its bulk on the tissues in which it is confined : in colour, it bears a strong analogy, to the mucus, secreted from mucous membranes, under the influence of irritation ; but the colour excepted, it differs from it, in almost every other respect. It is said, that mucus will float in water, while pus sinks to the bottom of the vase : this statement stands in need of explanation. The mucus of calculous patients, or of persons labouring under chronic inflammation of the bladder, does not float in the urine, but is deposited, and adheres, with great tenacity, to the bottom of the vase ; if detached with an instrument, and beaten up in the water, it will not dissolve in it, but floats as long as the water is kept agitated, in the shape of soft fleecy lamellæ, which subside without adhering again into a viscid mass, as soon as the water is allowed to rest ; pus, on the other hand has none of this elastic toughness, it mixes, or is dissolved, in a certain proportion in water, giving it a whey-like, or lactescent appearance ; the rest, falls to the bottom : if the supernatant fluid be poured off, without disturbing it, the pus will be easily recognized by its greyish white colour, and inelastic oily flow, when the vase is lifted upon its side. Pure mucus is always characterized by this viscid tenacity. When the mucus voided in the stools, in vomiting, in expectoration, or in the urine, assumes a greater degree of opacity, and becomes puriform, it is often of great importance to determine whether the fluid voided, be not the matter of an abscess, developed in the tissue itself, of those organs, or of the neighbouring parts ; the method above mentioned of examining the fluids voided, will be often found satisfactory, in lieu of other tests. (See Pus.)

Whatever be the character of abscesses, or however rapidly or slowly, they may be formed, some pathologists have considered that their march might be divided, into three periods ; in the first, the pus is secreted in the cells of the inflamed structure ; these cells successively break into each other, and form a common centre. In the formation of this cavity, however, there is no real loss of substance, the walls are simply forced apart, and condensed. In the second period, the abscess is matured, and if not masked by thick and resisting parts, it tends towards the surface of the body, under which, it presents itself, in the form of a tumour. The movements of a fluid can now be discovered in the tumour, by palping with the fingers alternately, two points of its surface ; and this undulation, in various degrees, is the peculiar characteristic of the fully formed abscess, the facility and certainty of the diagnostic, being directly relative, to the fulness of this fluctuation. The third period includes the termination, which may be effected by *resolution*, in which the pus is absorbed, the cavity which contained it disappearing ; or by evacuation through spontaneous or artificial openings. When the *termination* by either of these modes of opening, proceeds favourably, the pus is at once, or gradually discharged ; the cavity which contained it becomes by degrees narrower, till its sides join again, and little or no trace, save a slight degree of induration and redness, and perhaps a little more than the usual sensibility of the parts, remains to mark the situation, in which it had been developed. Of the less favourable termination of abscesses, we shall speak hereafter.

We have passed in review the different anatomical states of an abscess, from its commencement, to the period when an accidental membrane, circumscribes the purulent collection.

Let us now examine the nature of the boundary, which isolates the pus, from the surrounding tissues, and the functions which it performs. The conditions of this wall, or cyst will be found to vary, according to the degree of rapidity, or slowness with which the abscess has been formed, the parts which it occupies, the intensity of the phlogosis in the surrounding tissues, &c. In the acute abscess of rapid formation, the development of the cavity is too sudden, to allow the cyst to be much altered, from the condition of the cellular tissue, which surrounds the centre of irritation ; but when it takes place slowly, and in parts, abounding in the cellular element, as for instance, in lymphatic ganglions, or in the interstices of deep seated muscles, its walls attain a considerable degree of density and strength. The cellular tissue being the chief constituent of this boundary, whenever an abscess is formed in organs, where this element is scanty, the cyst will be in the same degree attenuated ; thus, in the soft parenchyma of the brain, it will have the appearance of a delicate vascular membrane, which can be scarcely distinguished from the substance of the brain itself.

The functions of this boundary or cyst, are by no means limited, to confining the pus, within the living organs, but form in themselves an interesting feature, in the history of purulent collections. The external surface of this accidental sac is continuous with the surrounding parts, and on this connexion, its life depends ; its internal surface which is in contact with the pus, on account of the exhalation and absorption which take place upon it, furnishes points of analogy with the natural secreting membranes. This surface is of a reddish grey colour, and tomentous or filamentous texture. The pus within this cavity therefore is not in the condition of a foreign body, but is continually acted upon by the internal surface of the sac modifying its quality, increasing or diminishing its quantity, according to the activity of the functions proper to it. Nor can the pus itself be regarded as destitute of vitality, for it maintains its properties without alteration by chemical agency; and when the functions of its living covering are so directed by the powers of the œconomy, is capable of being again taken up by the absorbents, and after undergoing the changes of absorbed fluids, of being eliminated from the body, or again poured as living blood into the torrent of the circulation. Under various degrees of stimulation, this fluid may become more or less consistent, and even impregnated with substances taken into the body. Upon this fact of the vitality of the envelope of an abscess rests all the hopes of the pathologist, to obtain, by appropriate treatment, or by the efforts of nature, the spontaneous resorption of the pus, and the consequent rescuing of the patient from the inconveniences, and even the dangers too often resulting from its external evacuation.

The phenomena which we have been hitherto contemplating belong, in the majority of instances, to inflammation of an acute character, arising suddenly and with a greater or less degree of violence. But there is still a numerous class of abscesses in which the preceding irritation is either very moderate or so feeble as to be scarcely perceptible, and in which, nevertheless, the collection of pus, though slowly effected, may be very considerable. These abscesses are almost exclusively confined to the cellular tissue, and are chiefly subcutaneous. They are observed to occur mostly in weakly subjects, persons of a scrofulous constitution, or who have been much subject to rheumatism; their seats of predilection are the covering of the chest, the neck, the pelvis, the loins, and the upper part of the thigh; and when in this last named situation, may be easily confounded with another species of purulent collection, *the abscess by congestion*. As it has been already observed, they are often preceded by so little pain or heat, that they attract no notice till the fluctuation is fully discernible. But their formation is often preceded by chronic engorgement or induration, which is dissipated as soon, or soon after the fluid is recognizable; in such cases the progress into the suppurative stage is exceedingly slow, and will mostly require to be hastened. The process itself differs considerably, not only in degree but in effect, from what takes place in the *hot* inflammatory abscess. On account of the slight irritation and increase of blood in the parts affected, the abscess, instead of being made up of a large number of small collections, first presents itself as one focus to be gradually enlarged. The fluctuation, too, even in its earliest stage is more manifest, for as the pus of the inflammatory and rapidly formed abscess is more consistent, so the pus in the cold or slowly formed abscess exhibits the reverse of this quality; it is thin, serous, greenish, not unlike whey in which small portions of the curd may be still discovered. When the irritation has been too obscure to be remarked, and the fluid is very thin, pale, and transparent, it would seem more like the effect of some unknown perversion of the nutrient function in the parts, whereby the natural exhalation in the areoles of the cellular membrane is altered, than the product of any inflammation, however slight in degree. These are the common characters of pus in these abscesses; but there are also in this respect many varieties. It is sometimes charged with shreds of cellular membrane, sometimes as consistent and transparent as the vitreous humour of the eye, and sometimes also more consistent still, like honey, or softened lard, thus forming as it were a link between the contents of abscesses and those of tumours of a melicerous or steatomatous nature. The slowness with which the chronic abscess is developed produces a corresponding influence on the formation of its walls: the wall itself is thicker, more perfectly organized, and from this greater condensation, in some instances, it comes nearer to the character of cysts or encysted productions, and there is little or no trace of inflammation to be discovered in the parts surrounding the cyst: the internal surface is greyish red, soft, villous, and, excepting some irregular productions, is so distinctly membranous as to resemble mucous surfaces. When the abscess is fully formed, it presents itself immediately, or almost immediately, under the skin as a soft, indolent, circumscribed, undulating tumour; the skin is readily moved upon it, and retains its natural colour and sensibility, except when the distension becomes very great, and the abscess is on the point of bursting.

In the two preceding varieties of abscess, we have seen that the matter is formed in the parts which had been previously irritated; there is however another variety of this affection, which differs from them in this respect, as well as in the cause that gives rise to them, and which on this account, may be designated as the symptomatic abscess. It depends not upon an irritation in the parts surrounding the collected pus, but on the affection of some other organ, neighbouring or remote, and of which it is an evidence, or a symptom. If the part primitively affected be surrounded by very loose and permeable cellular tissue, and the pus be formed by slow, and insensible degrees, it easily makes way through the loose membrane, without irritating it in a perceptible manner, and, according to the resistance it may encounter, gravitates, either in a direct or tortuous course, as it is impelled, by the action of the muscles, or the pressure of the surrounding parts, into more declive situations, at variable distance from the place where it was first poured out; thus forming the tumour, known as the *purulent depôt* or *abscess by congestion*. True it is that many abscesses may be symptomatic of a local affection, which differ much from that here characterized as such. But in the present instance, we mean the species which depends most commonly on caries, or any other organic alteration of a bone, on the softening of the vertebræ, the erosion of their fibro-cartilages, &c. The pus formed in osseous tissue meets its greatest resistance at the very outset of its progress, in the periosteum and fibrous capsules: from the action of the pus on these structures, or perhaps, more correctly, in consequence of the inflammation extending to them, they fungate, and thus becoming softened and weakened; the pus perforates them, and fuses into the surrounding cellular tissue, and takes its course along the interstices of muscles, or the line of vessels and nerves from above downwards, making its way towards the surface of the body.

The term "congestion" however requires further qualification. Pus congested, that is to say, accumulated in a situation more or less remote from its principal source, is not necessarily the product of diseased bone, ligament, or cartilage; such accumulations of pus may take place without any of these structures being at all affected. When matter is formed behind the peritoneum after simple psoitis, either in the cellular membrane connecting the psoas muscle with the vertebræ, or in the body of the muscle itself, instead of making way to the surface in its immediate neighbourhood, which it could not so easily do on account of the compactness and resistance of the parts it would have to pass through, it descends in the same course of gravitation, favoured by the laxity of the cellular tissue, which opens a passage for it, by the vertical attitude of the body, and by the movements of the muscles and abdominal viscera, until it can manifest itself externally as a fluctuating tumour. Abscesses by congestion therefore, though so frequently connected with and dependent upon alterations of the osseous structure, as to form in a manner the type of this species of abscess, are not necessarily so, for the pus of any other abscess would be congested in like manner, if the same causes existed to produce the displacement of the fluid, the matter in any case being collected in a declive and distant situation only because a certain condition of parts precludes its being collected near its source, while that of other parts favours its descent and accumulation farther off.

But to whatever disease these abscesses owe their origin, they form tracks, according to the case, running from the vertebræ of the back or loins, and even from the transverse processes of these bodies, from the posterior extremities of the ribs, from the internal surface of the bones of the pelvis and sacrum behind the peritoneum, along the pillars of the diaphragm, in the course of the psoas muscle, along the inguinal canal, under the crural arch; or in the pelvis, along the junction of the sacrum and ilium, following the obturator, or the gluteal vessels according to the resistance the pus encounters and even sometimes along the course of the ischiatic nerve, till it forms a fluctuating tumour externally, appearing most frequently in the groin, and sometimes in the upper part, and upper and inner part, or at the upper and back part of the thigh, at the under edge of the gluteal muscle, in the perineum, at the verge of the anus and vagina. These are by far the most frequent situations in which this species of abscess occurs; but they are also observed close to the knee, on the internal, external, or posterior part of the thigh, symptomatic of the disease, so improperly termed, spontaneous luxation of the head of the femur; and on the lower part of the circumference of the arm, when the shoulder is the seat of the primitive affection.

The anatomical conditions of the symptomatic abscess deserve particular attention. At its source, the bones are more or less profoundly attacked, presenting the different varieties of discolouration of substance, friability, softening, disappearance of the lamellar structure, and destruction of substance, which characterize the morbid alterations of bone; the periosteum, or other annexations are in a softened and fungous state; the walls of the passage by which the pus drains down, as well as those of the reservoir which receives it, are engorged, thickened, and sometimes as firm as cartilage. This canal, which is commonly more or less tortuous, ends in an extensive cavity filled with pus, which manifests itself as an indolent and fluctuating tumour, in one or other of the situations above mentioned, with or without an external opening. The lining membrane of the cavity is vascular, thin, of a greyish dark colour, and capable of great activity, more especially when atmospheric air has been allowed to penetrate into the cavity of the abscess. The skin covering the tumour retains its natural colour and mobility, and is free, at least at first, from any engorgement that may have preceded or prepared the way for the arrival of the pus at the surface.

The pus itself in these collections presents various degrees of elaboration. When first discharged, it is thin, mixed up with albuminous shreds, clots of blood, and fragments of phosphate of lime, and is of a greyish yellow, or sanious colour. At this time it has a faint disagreeable odour, but after the abscess has been opened a few days, and the air has penetrated into it, it becomes highly fetid, exhaling a smell peculiar to the suppurative destruction of bone.

Authors have dwelt much in particular description of lumbar abscess, setting it apart, as it were, from abscess of every other kind. The differences which it presents from other varieties are merely such as depend on their cause, progress, and situation; the general character is however the same. It is sufficient to sketch its prominent features in this article, and as the purulent collection in these instances is itself nothing more than the symptom of another disease, for its particular characters and pathological anatomy, we shall refer to the articles, Caries, Diseases of the Vertebræ, &c.

Having now considered the general characters of abscess, we shall notice a variety of this affection, in which the membrane circumscribing the pus is wanting, the inflammation is diffused, and the accompanying general symptoms are of a formidable character. This form of abscess is described by Duncan under the name of diffused phlegmon, and is more commonly known, under that of Phlegmonous Erysipelas. It is observed to occur in persons of bad habit of body, who have undergone severe labour and hardship; it occurs also after inoculation by dissecting wounds. It seems not to depend so much on the *seat*, or *intensity* of the inflammation, as on its peculiar *nature*, and the absence of any disposition in the economy to furnish the plastic principle, without which the circumscribing membrane of abscesses cannot be formed. In this variety, we do not find a single cavity, but a considerable number of small spaces, having externally for boundary the skin thinned, detached, and sloughy; it also burrows deep between the muscles, separating them as it were with a scalpel. At first there is very little pus distinguishable in a much greater quantity of bloody serum, with which the cellular tissue seems impregnated. When these collections are opened, and the inflammation becomes circumscribed, the matter is isolated as in the ordinary phlegmonous abscess, by the production of the proper membrane of such collections.

Many varieties of abscess might be added to the foregoing if we were, in imitation of other writers, to establish them on the nature of causes, or on the dependence they may have on certain morbid states of the body. But such a mode of dividing the subject would be no longer in accordance with the spirit of exactness that characterizes the present state of pathology. Abscesses under the titles constitutional, scrofulous, rheumatismal, syphilitic, &c. cannot therefore find a place in this article. Abscesses produced by the irritation of foreign bodies, liquid or solid, whether introduced from without, or produced in the body, such as urine, fæces, bile, blood, milk, saliva, &c. are also excluded. In this place a simple indication of them will suffice as they form the subject of special consideration under their respective heads, to which the reader is referred.

Progress and termination of Abscess.—Inflammation occurring in the living tissues may at any period of its progress be arrested and extinguished, even though it shall have proceeded to the full formation of pus. But the probability of such an event is greater before the inflammation has proceeded to its height, or been followed by those changes in the condition of the parts which precede or accompany the formation of pus. This extinction of the inflammation and resorption of the newly deposited fluid, takes place under various influences, but whenever the case is so, the resorption is preceded by the disappearance of all the local symptoms of congestion and phlogose. The circulation at the circumference of the tumour becomes less frequent; its redness, swelling, and heat are lessened; there is exudation of thin serum from the vessels of the part, or on the secreting surfaces; the tumour softens and subsides, and the sense of fluctuation can no longer be discovered, and the patient is relieved from all the inconvenience and danger of protracted suppuration. The process by which this most favourable termination is effected, is known by the name of *Resolution.*

In very rare instances, where the inflammation, having been slight, has disappeared, and the pus is not absorbed, the walls circumscribing it become thickened, and the abscess remains stationary like any other foreign body that has been isolated from the living parts by a cyst. But we must not often expect to see the purulent absorption and exhalation in the abscess so nicely balanced; one of them predominates, most commonly the exhalation, and hence the progressive enlargement of the cavity. But when the inflammation is very severe, and the texture of the parts has suffered in a greater degree, pus is formed in quantity, the absorbents show no disposition to remove it, and the mass of fluid continues to increase more or less rapidly in proportion to the degree of irritation kept up by its own presence, by the further extension of the inflammation into the surrounding parts, or by a purulent exhalation from the walls of the puogenic cyst. Rebellious to the power of absorption, the pus now falls under that of another general law of the economy, in virtue of which it endeavours to expel all foreign substances capable of irritating the organs of the body. The pus, by its accumulation, compresses, displaces, and fatigues the surrounding parts, and tends towards the outer or inner surfaces of the body, mostly the former, seeking an opening for its final escape. The increase in quantity of the pus has an important share in effecting the transfer of the whole mass of fluid from the place of its original formation to the surface of the body: although pressing with equal force on all sides of the cavity that circumscribes it, it does not meet every where with the same resistance; its progress towards the internal surfaces is opposed by the mutual support which the internal organs afford each other; in a word, by the absence of cavity: not so the external surface; the only opposing power at the periphery of the body is the weight of atmospheric air and the texture of the integuments, towards which continuous tracks of cellular tissue may almost every where be found.

The progress of the pus towards the surface is not, however, a simple result of compression and distension in that direction; they excite or combine with an organic movement, which requires to be noticed. The compression and distension become strongest in the direction in which the resistance is weakest, exciting inflammation and ulcerative absorption, and this process continues to remove every barrier till it attacks the skin itself, which is often perforated at several points over the abscess. A remarkable effect of this processional process is the adhesion which it establishes between the walls of the abscess and the parts upon which the purulent cavity advances. The skin, covering a deep seated abscess, at first shows no sympathy with it; as soon however as the pus begins to advance, all the elements in succession sympathize with it, till the skin, in its turn, changes colour, becomes blue or dusky red, adheres to the wall of the abscess, and ulcerates with it. Hereafter we shall see that this march of irritation is of great value in helping us to detect deep seated abscess, as well as in pointing out the existence of that degree of internal adhesion, without which the opening of many purulent collections would be attended with danger of fatal effusion into other organs.

The most formidable obstacle to the transfer of deep seated pus to the surface, is encountered in the fibrous tissues and inextensible aponeuroses which occur in its direct course. The vitality of these structures being too low to sustain the ulcerative process, the pus, when thus obstructed, burrows, and, as it were, dissects its way along the cellular tracks, sometimes against its own weight, until by finding an opening it is enabled to resume its direct course outwards; and thus are explained the flexuosities which are sometimes found in the course of an abscess. The progress of the matter, when opposed by a great extent of aponeurotic surface, is sometimes favoured by the openings it may offer for the transmission of vessels or nerves: it works its way through these openings, thus shortening its course towards the skin. In such cases, the matter is divided into a superficial and deep-seated collection, connected by the narrow opening in the fascia or aponeurosis. Instances of this bilocular condition of the abscess occur in inflammations of the sheaths of tendons, in abscesses external to the pleura, passing through the intercostal spaces, and spreading under the skin. While the anterior or moving wall of the abscess is thus thinned and advanced, the posterior one remains stationary, or becomes thickened in a considerable degree.

The compression and distension, however, may take the opposite direction, and tend towards the internal surfaces of the body. In this respect, the result depends on the resistance opposed by the surrounding parts to the extension of the purulent sac. There are numerous instances of abscess, formed not very distant from the external surface, which have, notwithstanding, been evacuated through some internal organ. Abscess, under the strong aponeurosis of the parotid, often bursts into the mouth; abscess of the liver into the colon, the duodenum, and stomach; abscess of the right iliac fossa into the cæcum, or even into the bladder; abscess of the kidney into the colon, &c. It is related of the son of Petit that he died of an abscess between the ribs, which burst into the cavity of the pleura. Similar cases are on record as affecting the peritoneum. The fact related of the son of Petit will appear the more curious when contrasted with others in which abscess of the substance of the lung has been known to produce adhesion of the two folds of the pleura, and destruction or wasting of the intercostal muscles, the abscess pointing under the skin. A remarkable case of this nature presented itself lately to Mr. King, in which the pulmonary abscess burst through the nipple, evacuating a large quantity of matter.

The general progress of purulent collections is, however, from within outwards, even when developed in contact with serous membranes, for, as it has been already observed, the surface of serous membranes is fortified by the organs which they envelope. Indeed the bursting of abscess into serous cavities is very rare; and this is easily explained, because, as soon as the irritation reaches the visceral portion of the serous membrane, it secretes plastic matter which pastes it to serous membrane lining the walls of the cavity, or to the serous envelope of some neighbouring hollow viscus: this plastic lymph is rapidly organised, and if the abscess continue to point internally, the inflammation, by agglutinating all the parts, obliterates that point of the cavity into which the pus would else penetrate; the parts thus fused together are in their turn attacked by the ulcerative process: the mode by which the transfer of the matter is effected is still however the same, nature establishing continuity of tissues where contiguity only had existed. We may repeat, however, that the tendency inwards is rare, and probably never occurs unless when favoured by some morbid condition of the sac, backed by the resistance in the opposite direction of strong fasciæ and aponeurosis. It would, however, be an error to attribute the enlargement and extension outwards of the purulent sac to the mechanical force of compression and distension alone. Pus, shut up in bony cavities, dilates and thins their walls before it softens and perforates them; instances of this expansion are seen in the antrum, the frontal sinuses, and even in the cranium itself; and it is doubtless the effect of some modification of their nutrition.

When the pus arrives under the skin, the integument adhering to the wall of the abscess is gradually thinned to the tenuity of an epidermic pellicle, and the continuance of the processional process of ulcerative absorption is manifested in the appearance of one or more phlyctenes, through which the matter soon oozes or bursts out.

If the cavity of the abscess be small, and the spontaneous opening sufficient, it may be entirely evacuated at the moment, and the sides of the cavity may become agglutinated in twenty-four hours; an effusion of organizable lymph replacing instantaneously the puogenic action. But this does not often occur. In general after an abscess is opened, a new series of phenomena arises; and these, it is stated, are much modified by the admission or non-admission of air into the interior of the abscess.

It is remarked when an abscess opens spontaneously, that all the pus is seldom evacuated at once; it comes away gradually, and in quantities barely sufficient to relieve the walls of the cavity from tension. This is the case in almost all considerable collections. The wall of the abscess thus accommodating itself to the volume of the fluid, the air is kept excluded, there being no vacuum formed to compel its entrance. The maintenance of this condition in evacuating large abscesses is considered so favourable, that surgery aims at imitating it by the plan of the oft-repeated small punctures, instead of large incisions.

When air penetrates into the cavity of an abscess, symptoms of increased irritation are speedily observed to follow. The parts covering the abscess become hot; the redness, pain, and tension return in an augmented degree, and there is fever of variable intensity. This effect of the admission of atmospheric air has been the subject of controversy. It is generally supposed that the air determines putrid decomposition, the elements for which, viz., air, warmth, moisture, and decomposable matter, are all present, and that the inflammation which attacks the puogenic membrane is the consequence of this decomposition. The inflammation of an extensive membrane re-acts on the principal organs of the body, which manifest their sympathy by disturbance of function; thus explaining the fever, vomiting, diarrhœa, &c. The renewal of the inflammation and the decomposition of the chemical elements impart to the matter issuing from the focus a degree of fetidity that is almost intolerable. These changes are remarkably rapid, for the pus, which at the first opening was of good quality, assumes a bad character; it becomes thin, sanious, and excessively acrid.

M. J. Cloquet dissents from this opinion as to the effect of the introduction of air into the abscess, in producing an alteration in the qualities of the pus; he thinks, that the putrid fermentation takes place from the want of pressure on the fluid, and that gas is evolved from it, whether the atmospheric air be excluded or not. But there is no necessity of adopting either of these opinions literally. It is by no means probable that the pus of the abscess is thus altered, in consequence of the chemical decomposition of its elements; it is much more rational to suppose that the pus is secreted of a bad kind, from an unhealthy modification of the organ secreting it. No one entertains any doubt that high constitutional irritation follows the opening of these collections, and many persons will be disposed to admit that the inflammation or irritation of internal organs may have a good deal of influence in deteriorating the qualities of the pus, the more especially as air has been known to penetrate into abscesses, without being attended with these consequences, and it is also matter of observation, that the condition of the pus, whether of an abscess, or an open wound, alters and becomes worse, when the internal organs are irritated and their functions disturbed. But whatever be the value of this reasoning, the exclusion of the air from the cavity of a large abscess is looked upon as a point of some importance, and when secured, is a chance more in favour of the patient. But this advantage cannot be insured with the same facility in all cases, and in some it is wholly unattainable.

When the membrane of an abscess is surrounded by soft and moveable parts, it may subside so accurately and regularly upon its contents, as to be adjusted to the quantity evacuated. But when it is fixed to bones, or immovable parts, this facility of accommodating itself to the bulk of the fluid is wanting, and the air rushes in whenever the sac and its contents become disproportioned, as inevitably as air rushes into a bottle, from which a fluid is poured out. The mobility of the walls of an abscess has a marked effect in diminishing the danger arising from the quantity of the suppuration, by facilitating the gradual but rapid adhesion of its sides; in other words, the danger of exhaustion is often relative to the extent of the suppurating cavity, and the fixity of its walls, independently of the nature of its cause.

The puogenic membrane undergoes remarkable changes consequent upon the discharge of the contents of the abscess: the greyish flocculent surface becomes more vascular, and granulates in the same manner as the surface of a wound; the sides bud out firmly, all tending towards the centre; the extent of the cavity diminishes rapidly, the sides at last unite, and the cavity disappears. The tissue of new formation is at first plastic or lymphlike; it becomes more and more firmly organized, and is at last undistinguishable from the cellular structure surrounding it.

But it also happens when an abscess is once opened that the purulent matter continues to be furnished for an indefinite period: the pus, however, is the only feature of the disease that remains the same, for the space which the collection occupied contracts, and the walls become thickened, fibrous, and even cartilaginous.

Diagnostic of Abscess.—When suppurative inflammation attacks a part, it may run very rapidly through its different periods, more especially if it occur in parts, abounding in the cellular element. The facility of the diagnostic, as to physical signs, will be relative to several circumstances, such as the superficiality, or depth of the collection, the mode in which the pus is diffused, its quantity, its liability, on account of situation, to be confounded with aneurismal or other tumours, the nature or fluidity of the pus itself, the degree of distension which it makes upon its cyst, its being masked by a strong, thick, and unyielding, aponeurosis, &c.

The existence of an abscess is readily recognized when the fluid forms a tumour near or under the surface, presenting a soft, salient, deep, red, blueish, or whitened point in the centre, or when the covering of the tumour is thin, and the matter of the collection is fluent; under these circumstances, the local characteristic sign, fluctuation, will be most manifest. In order to determine the undulation of the fluid, we should proceed in the following manner: the side of the tumour should be covered with the palm of the left hand, or the ends of the fingers united; slight shocks should then be communicated to the opposite side, with the fingers of the right hand. Under the impulsion the fluid of the abscess is agitated, and the left hand reposing upon the tumour, perceives clearly the movement of the fluid displaced by the impetus. The left hand should be kept in perfect repose, for if the fingers, covering different parts of the tumour, are made to press on it alternately, the sensation will be much less defined; and in a case of obscure or deep seated abscess, such a mode of investigating would be of no value, as the sensation would not differ sensibly from the vibration obtained from parts in a state of simple engorgement. But though recognizing fluctuation as one of the principal physical signs of abscess, it is right we should be on our guard against some of the illusions of touch. The inflammatory swelling of the cellular tissue, when it is loose, free, and highly extensible, communicates an elastic feel, which simulates fluctuation; this is particularly the case on the back of the hand, and in the vicinity of the articulations: the infiltration of serum may simulate the undulation of pus in the same manner. The dartos, when the testicle is inflamed, is thus infiltrated without there being a hydrocele; and rheumatism, produces effusion in the neighbourhood of joints, which may also impose upon the practitioner.

The physical signs, however, form but a part of the groundwork of the diagnostic of abscess. In addition to these, there are others no less remarkable and important, some of a local and some of a constitutional nature. The change from inflammatory engorgement to the maturation of pus has its peculiar signs, which are developed with the progress of the malady in the part itself: the intensity of the inflammation somewhat abates, the heat, redness, and symptomatic fever diminish; the character of the pain is altered from a quick, burning, pungent throbbing, to one in which a sense of fulness and weight predominates; the tumour becomes larger; and, softer, and finally, the epiderm is separated from the derm. At some period while these changes were taking place, most commonly towards the end, constitutional symptoms have arisen, manifesting themselves in the larger and softer pulse, and in short irregular rigors, which are felt over the back, down the loins and inferior extremities, &c.

The rapidity with which these phenomena succeed each other, as well as their intensity, depends on the violence of the preceding inflammation, and the extent of the suppuration. If the irritation be slight, and the pus formed in small quantity, the constitutional disturbance will be slight also, and sometimes imperceptible; when, on the other hand, they are considerable, the symptoms attain their maximum of intensity.

If the ulcerative process be suspended before the collection reaches the skin, a permanent centre of irritation succeeds to the violent inflammation, through which the suppuration was first established; the abscess remains unopened, its walls thicken and become the seat of latent or chronic inflammation, the signs characterizing which, are soon shown: the pulse is small and frequent, the appetite fastidious or null, the hands and feet are hot and dry, irregular or nightly sweats break out, and the strength, consumed in the struggle of hectic fever, fails more or less rapidly, in proportion to the extent and situation of the abscess, the sound or deteriorated habit of the patient, &c.

When the physical signs are fully manifested, and they coincide with the remission of the inflammatory symptoms, with a sense of weight in the part, and irregular rigors, there can be no doubt of the formation of an abscess; but pus is often formed without any remarkable manifestation of local or constitutional phenomena, or at least they may be so obscure and latent, as to require the nicest discrimination to detect them. Pus may be formed in the liver, kidneys, mediastinum, mesentery, ovaries, and other internal organs, without any more frank indication of their existence, than that of some vague and indefinite sense of weight, or pain in the part. The obscurity, or even total absence of such indication, is the subject of common remark with every pathologist, as connected with the development of those purulent collections which take place in the liver, lungs, pleura, brain, &c. after amputation, the extirpation of tumours, falls, &c. (See PURULENT DEPÔT.)

In such cases, that is, when the internal organs are the seat of inflammation and the depôt of pus, if the local phenomena are obscure or entirely wanting, we must help the diagnostic by investigating the general state of the patient, and the changes or perversion of the functions of the suspected organ. Under such circumstances, we should take account of the frequency of the pulse, the heat and dryness of the skin, the intensity of the thirst, and examine, according to the case, the manner in which the brain, lungs, the digestive and urinary organs, &c. perform their functions. In spite, however, of every precaution and care in these cases, as well as in those of abscess even of the cellular tissue, at a distance from the surface, or masked by thick and inextensible parts, it will be often impossible to discover the purulent collection. Take, for example, the case of an abscess formed in the deep intermuscular cellular tissue of the thigh; the pain preceding the formation of the pus may be too inconsiderable to attract attention; the swelling, extensive and undefined, tends rather to obscure than elucidate the nature of the case; the skin remains unaltered: the abscess is formed before there is any ground even to suspect its existence.

The obscurity is not removed till the quantity of the fluid becomes considerable, and even then it does not furnish the physical signs of its presence with anything like the same clearness, as in the extensive superficial collection. Pressing the swollen mass at different points with the fingers, or embracing it more amply with the whole hands, will not obtain for the surgeon the same evidence of fluctuation. In such cases, however, there is one indication which we should not fail to look for, viz., the *doughy* state of the soft parts external to the purulent collection. This pasty condition of the subcutaneous cellular tissue, in the absence of well marked fluctuation, is a valuable addition to the other remote, sympathetic, and functional signs of abscess, tending, if the rational signs be also present, to dispel all doubt in diagnosticating deep seated abscess of the limbs, of which it is by some surgeons deemed an almost unerring indication. It will guide us also in discovering, in conjunction with those signs, pus formed, either in the articulations, or in the organs occupying the cavities of the body. The detection of purulent collections in obscure cases nevertheless frequently requires the exercise of great judgment, habit, and tact.

When an abscess has been developed slowly in deep-seated parts, and its investing cyst has acquired considerable thickness, the diagnostic is difficult; the collection may be mistaken for a tumour of encysted, steatomatous, or other nature, and it will only be by taking into account the previous degree of irritation, by seeking to appreciate the fluctuation however obscure, the greater or less defined circumscription of the tumour, and by carefully observing its progressive increase, that the conduct of the practitioner will be most safely guided.

The recognition of pus formed between the interstices of muscle, covered by thick and inextensible aponeurosis, is also a matter of much difficulty; and though local and constitutional symptoms will often run high, the practitioner will still remain much embarrassed, and the more so, as the limiting the ravages which the pus may occasion depends entirely on his promptitude in giving issue to it. If an abscess of this kind be not timely detected, and the matter evacuated artificially, it may occasion irreparable mischief. We must not wait till the fluctuation is unequivocally evident, for if we wait for such an event, or leave the matter to its unchecked course, it will have time to fuse along the tendinous expansions, burrow in the interstices of the muscles, detaching them from each other and from the bones, denude the latter of their periosteum, which it softens or inflames, or arrive at some neighbouring articulation or natural cavity which it may invade. In order to diminish the obscurity which attaches to the formation of abscess under aponeurotic or fascial expansions, it is of the highest importance to the practical surgeon to study carefully the situations, direction, degree of resistance, and the natural apertures of those aponeuroses under which abscesses are observed to take place. Accurate data on these points will give him great confidence in discriminating and predicting the issues in such cases; and for this purpose we cannot do better than refer him to the excellent work of Blandin on this subject.

The difficulty sometimes depends on the mode in which the pus is contained in the parts in which it is formed; as when the containing cyst is very tense from the quantity of the pus, and is at the same time deep-seated; on the other hand, pus is sometimes diffused in the loose cellular tissue, infiltrating its areoles, and not collected into one cavity, or bounded by a distinct membrane; when fluctuation is sought for, it is not detected, the pus is merely displaced and driven into other points, and the surface does not spring up again, but remains pitted as in common œdema; this circumstance sometimes adds to the obscurity of sub-aponeurotic abscess also; instances of this kind will be observed under the pectoral muscles.

Superficial abscess occurring secondarily, or subsequently to inflammation of an internal organ may be sometimes overlooked, in consequence of the attention remaining exclusively fixed on the primitive seat of the inflammation; thus abscess in the perineum, or in the spongy body of the urethra sympathetic with urethritis may be overlooked: the same observation will also hold with regard to cystitis, abscess being here known to occur in the cellular tissue behind the muscles, above the pubis, &c. In such cases the inflammation is propagated from the neighbouring organ to the surrounding or vicinal cellular tissue, suppuration terminates the inflammation in the latter case, while resolution succeeds the former, though the cellular tissue was only involved in the inflammation, secondarily, and as it were by continuity; thus the walls of the abdomen present abscesses after peritonitis, the mediastinum and walls of the chest after pleuritis, the cellular tissue in the cheek or gums after toothache, &c. Abscesses developed externally to serous membranes after effusion has taken place into their cavities, though constituting a distinct disease, are produced by the influence of this same sympathy or continuity.

Abscesses formed in the mucous membranes of the outlets of the body, are in point of facility of recognition on the same level as those formed superficially, such as in the mouth, the lower end of the rectum, vagina, &c.

In phlegmonous abscess, the symptoms may be recognized, and the matter detected almost as soon as formed. We have the reverse of this in the symptomatic abscess; here all is obscure, slow, and uncertain, till the external fluctuating tumour becomes apparent. The tumour itself is not painful nor inflamed, nor is there any expectation of its appearance excited, by any previous sensation acknowledged by the patient; for the pain, heaviness, inconvenience, stiffness, or fulness which may be felt in the parts in which the pus is being formed, are insufficient to awaken suspicion. These however, with difficulty of respiration, dull sound in the lower part of the chest, puffed or swollen abdomen, marked alteration of one or more of the vertebræ, irregular fever, night sweats, and the effects of pressure on the double organs contained in the pelvis, will contribute to show the nature of the case; the collection itself will be rendered more manifest when the patient is in the erect posture; the matter gravitates, and if the course which it has taken in its descent be large and direct, a sensible movement of flux and reflux may be determined by the hand, the undulation being traceable to some extent up the abdomen; its elasticity and fulness are also increased by coughing or straining, or deeply inspiring. On the other hand, if the patient is in the recumbent posture the tumour diminishes. Some constitutions are known to present a sort of suppurative idiosyncrasy, the formation of pus occurring upon the slightest, and often without any ostensible cause. When such a disposition of the economy is known to exist, it will, of course, in doubtful cases, be taken into account in establishing the diagnosis. This disposition is developed in a remarkable manner in some acute diseases, as in confluent variola, gastro-intestinal inflammations, by the suppression of accustomed evacuations in soft, pale, and lymphatic habits.

Diseases that differ entirely from the nature of abscess are liable to be confounded with tumours of this nature. Aneurismal sacs have been opened for abscesses, and an abscess from its contiguity to large vessels, in the axilla and popliteal space for instance, has been left unopened from a fear of its being an aneurismal and not a purulent tumour. Certain physical signs in such obscure cases are of great utility in guiding the surgeon to a correct judgment; amongst others, the conical elevation of the purulent tumour in the middle, and the gradual diffusion or sinking of the base of the tumour at its circumference.

Prognostic of Abscess.—Between the two extremes of a superficial phlegmonous speck of matter, and an extensive abscess formed in the depth of our organs, of course there is a vast field to exercise the surgeon's skill in prognostic; the former unimportant, almost imperceptible, and impeding in no wise the healthy action of the powers of life; the latter disturbing those powers, arresting or destroying organic functions, and proving necessarily, and more or less rapidly, fatal. The gravity of an abscess depends on the one hand on its extent, and on the other hand on the nature and importance of the parts in which the matter is formed; frequently this last is the only important consideration, and the abscess proves destructive of life whether it be extensive or not. On this account abscesses in reference to their seat or situation in the brain, lungs, heart, liver, kidneys, all organs essential to life, or in the neighbourhood of such organs, such as infiltrations of pus in the cellular tissue of the abdomen, and of the pelvis after peritoneal inflammations, or operations performed on these parts, are more unfavourable than when they are situated superficially, or in the interior of members or articulations.

The next in point of gravity are those which are symptomatic of a lesion of the vertebræ, the abscess by congestion, and generally all collections, wherever situated, or from whatever cause produced, which are extensive, and which furnish pus in too great quantity. We do not however mean to state, that all abscesses of this kind, or even of internal organs essential to life, particularly when nature prepares an outlet, are necessarily fatal; this would be contrary to experience. But under such circumstances we may affirm, that the cases terminating favourably are not sufficiently numerous to entitle them to be regarded in any other light than that of fortunate exceptions. It is, therefore, wholly impossible to determine in a general manner, whether a patient with abscess by congestion can be surely rescued from his disease by the resources of art or not. The first step towards even a probability in this respect should be grounded on an exact knowledge of the seat and nature of the affection, upon which the abscess by congestion depends. A simple psoitis, although accompanied with extensive inflammation of the cellular tissue, and furnishing matter of a large abscess, but without any constitutional affection of the neighbouring vertebræ, will evidently be attended with much less danger, even though the neighbouring vertebræ be denuded, than when the collection has sprung from a caries of those bones. When the cavity of the abscess is extensive, and its sides altered from the healthy structure, when they have become thickened and cartilaginous, and when the external openings have become fistulous, the drain to which the constitution is exposed from the absence of all disposition in the parts to heal renders the fate of the patient very doubtful. But even under these unfavourable circumstances, amelioration, and ultimate recovery are not to be despaired of. Instances of cure are recorded of Pott's disease of the vertebræ, accompanied with congestive abscess. Several remarkable cases attest the curability of abscess by congestion, under its severest forms. It was observed that the pus was absorbed and replaced by gaseous fluid, which in its turn was removed, and the accidental cavity was obliterated. Dupuytren observed in several subjects, partially obliterated tracks, terminating at the vertebræ, in which he could still discern the debris of tuberculous matter, but the pus had been totally absorbed, and the traces of disease of the vertebræ were alone discernible; and in another case of angular curvature of the vertebral column, in which the bodies of several vertebræ had been destroyed, the whole was perfectly healthy and consolidated; the psoas of the left side was wasted to a mere fibrous cord, the purulent cavity had disappeared without leaving any trace, either of pus or tuberculous matter. Such terminations, however, can only be confidently looked for under very favourable circumstances, and when the abscesses remain unopened; when they become fistulous, the case is all but hopeless. Nevertheless the prognosis is in most cases unpromising, as it requires the concurrence of many favourable circumstances, aided by the efforts of art, to bring about a fortunate termination. The extent of the purulent cavity in the symptomatic abscess adds much to the peril of the patient, although the prognosis is nevertheless to be deduced chiefly from the nature and extent of the primitive affection. One of the most favourable symptoms that can occur in these cases is the resorption of the pus; when this occurs, as it rarely does, the prognosis becomes altogether favourable, for it coincides with a favourable change in the primitive affection which ceases to make progress, and ultimately disappears. When on the other hand the purulent focus is vast, its walls are thickened, its surface chronically inflamed, and its tracks fistulous, the complications become truly formidable, the efforts of art are unavailing, and the patient's doom is all but inevitable. The rapidity with which a fatal termination arrives depends on various circumstances; if the recent openings of the abcess become large and fistulous, and the suppuration abundant; if the caries be extensive, and the abscess spacious and direct in its course outwards, the digestion is soon disturbed, fever is kindled up, nocturnal sweats set in, the body wastes, a colliquative diarrhœa takes place, which cannot be moderated, and the patient expires in the last degree of exhaustion.

The extent or volume of an abscess, in every case, has more or less influence on the result which may arise from it. In an abscess of large volume, the danger will be less in proportion to the mobility of its walls; or, in other words, of their power of constantly accommodating themselves to the quantity or bulk of the purulent matter: but on the other hand if the sides of the abscess be fixed by reason of their connexion with immoveable parts, the access of air into the body of the tumour upon the partial expulsion of the pus is facilitated, a circumstance which acts unfavourably as to the degree of inflammation which follows, the prolongation of the suppuration, and the ultimate cicatrization of the cavity. It has been already noticed that in the abscess of slow formation, or cold abscess as it is called, the walls are comparatively thicker and more distinctly organized than in the hot and rapidly formed abscess; this difference of condition has a marked influence on the progress of the affection. The vivacity of the inflammation in the latter case is, so to speak, extinguished upon the formation of the pus, which being treated as a foreign body and removed by art, leaves the parts well disposed to heal, which they accordingly do very rapidly: in the former the walls are thickened, and even in some instances have become solid and fibrous; while in this state they will not adhere, and cannot do so until such time as a new action shall so change their texture as to fit them for cicatrization.

Superficial collections are less dangerous than those that are deep-seated. Among the latter, however, there are many which have the same advantages in this respect as those which point to the surface, such as abscesses of the throat, pharynx, tonsils, &c.; other abscesses also, although situated in the substance of internal organs, participate in this advantage on account of their proximity or communication with other organs which have a natural outlet to the surface of the body: thus an abscess in the lung may be spontaneously evacuated through the bronchial tube; and in the liver, kidneys, walls of the bladder, stomach, and intestines, a ready and salutary issue is often afforded by the intestinal canal. But as respects the termination of abscesses, the most favourable, as it has been already stated, is that in which the pus is absorbed, as it dispenses at once with any painful surgical interference, and saves the patient from all the consequences of protracted suppurations.

In conclusion, it will be observed that in general the innocuity or danger of purulent collections depends on their volume, situation, progress, &c. But we should not omit to state, that there are instances of abscesses occurring in different parts of the body during the course of acute diseases, particularly in severe fevers accompanied with gastro-intestinal lesions, and in which their appearance has the most marked influence on the progress and termination of those diseases.

These abscesses are frequently indicative of, and are a consequence of, a change in the irritation prevailing in important organs; and when such is the case, their appearance is eminently salutary, except when the abscess is formed in an organ essential to life. Examples of this species of abscess denominated critical, occur under the strong sheath of the parotid gland in gastro-encephalitis, about the angle of the jaw, in the ear, in the groin, in certain mild cases of the plague, in the axilla, &c. These critical abscesses are accompanied with marked remission of the previous symptoms. On the other hand, when they do not coincide with a transfer or cessation of the irritation from the organs already labouring, they constitute a formidable feature of the case.

Treatment of Abscess.—The curative indications of abscess may be, to a certain extent, inferred from what has been already laid down in the preceding part of this article; the terminations, as it has been already stated, are, 1st, The spontaneous absorption of the matter; 2nd, Its evacuation through ulcerous openings. But it may also happen that the pus may remain stationary in its cavity, abstracted as if it were a foreign body, isolated by an accidental cyst from the living actions of the economy; this, however, is not a termination, but rather an indefinite protraction of the disease, which sooner or later will require the aid of art to effect a cure: in this state, absorption of the matter may be promoted by the application of a blister to the tumour.

When nature is left to her own resources, she relieves the parts from the matter which distresses and impedes their functions by one or other of these modes; and when art interferes, it cannot do otherwise than imitate her. The precise line of conduct which the surgeon may adopt in any given case, must mainly depend on the judgment he may form with reference to all its circumstances. But his efforts are limited to the excitement of the process of absorption on the one hand, or to the evacuation of the pus, and the providing for the adhesion of the parts by proper internal treatment and dressings on the other.

The matter of an Abscess is sometimes absorbed.—An abscess, when left to itself, like serous effusions in the natural cavities, or infiltrations in the cellular tissue, will sometimes be dispersed; the pus is absorbed either slowly or rapidly, the cavity in which it was deposited is effaced, the fluctuation of the fluid and the tumour which it formed can be no longer recognized. The process is effected by the sole and unassisted efforts of nature, with or without any remarkable phenomena; or while the abscess disappears in one place, another forms in a distant part; or finally, the resolution of the local inflammation, and the absorption of the matter, are accompanied by some sudden and remarkable evacuations, such as diarrhœa, copious urine, depositing abundant sediment, viscid and odorous sweats, &c.: such cases are not unfrequent.

As resolution is the best termination of inflammation, so is resorption the best also either of purulent collections or of serous effusions; and whenever any reasonable hope of such an event can be entertained, from a due and salutary excitement of the powers of the economy, it should not be lost sight of. Allusion has been already made to the case observed by Mr. Wilmot, in which the pus of a psoas abscess was absorbed, and in which every trace of induration was finally dispersed by the use of a bandage and compress wet with a strong decoction of oak bark and alum. Mr. Crowther has also been successful in dispersing large collections of matter without opening them. When the surgeon aims at effecting the absorption of the matter, he employs, according to circumstances, internal or external remedies, or both conjointly; for the former, purgatives, diuretics, diaphoretics, alteratives, emetics, etc.; for the latter, frictions, with various stimulating substances, as iodine, muriate of ammonia, mercury, local bleeding with leeches, blisters, cold or hot effusions with simple or mineral waters, hemlock, bath, good air, &c. This imitation of nature is, however, at best but a gross one; for while she, for the most part, effects her purpose without much observable commotion, art can only produce a similar result by momentarily perturbing the actions of the economy.

It is not by any means an easy matter to determine in what cases the surgeon ought to endeavour to promote the resorption of the matter; but nevertheless we may state generally in what description of cases such an event has been observed to occur, either spontaneously or by the effect of internal or revulsive medication. The resorption of matter takes place most commonly from abscesses formed in the lymphatic ganglions. In such cases, internal medication may be attended with salutary effects; but the practitioner should proceed with great caution, and hold himself ready to resign his hopes of succeeding in this point as soon as his first efforts to effect the dispersion of the abscess are found to be fruitless, and particularly if the stomach and bowels are too highly disturbed or irritated by the action of the medicines employed.

External applications are observed to be most successful in the case of chronic abscess where the inflammation is moderate; in such cases, iodine, muriate of ammonia, affusions, mercurial frictions, flying blisters, &c. may effect the dispersion of the collection; but here again, our conduct must be cautious, for if they do not conduce to the end in view, they may render the local inflammation more active, and thus tend to the spontaneous opening of the tumour contrary to the wishes of the surgeon. On the other hand, the matter will in some instances be absorbed, while the treatment is directed to the maturation of the collection with a view to artificial or spontaneous opening. Thus while the surgeon is combating the local pain, redness, heat, and tension by means of local bleeding, emollient applications, &c. the tumour diminishes, the fluctuation becomes less and less distinct, and the matter is absorbed. This event, however unlooked for, is nevertheless easily accounted for. Doubtless the continuation of the local stimulation which first gave rise to the purulent collection is one of the chief causes of its gradual increase; for as long as it possesses any great degree of intensity, the cyst of the abscess remains vascular, tense, and painful, and its exhalation is continually adding to the quantity of pus already formed: the quantity and rapidity of this exhalation bears the same direct relation to the intensity of the local irritation, that the absorption of the matter, when it occurs, does to the abatement and final extinction of the inflammatory action in the tissues surrounding the pus. Under the influence of simple antiphlogistic treatment of the case we are now contemplating, the balance between exhalation and absorption is turned in favour of the latter, and this condition being maintained by persistence in the antiphlogistic action, the pus is gradually removed, and the cure is obtained spontaneously. One word will suffice to expose the advantages arising out of the antiphlogistic course. When the inflammation runs high in the walls of the purulent cyst, the cyst treats the contained fluid as a foreign body, from which it seeks to be relieved, but if the local irritation be appeased, the pus is not so irreconcileably offensive to the powers of the organism, is not treated necessarily as a foreign body, but may be absorbed. Examples of the dispersion of abscess are not few, more particularly in the lymphatic ganglions, and in articular inflammations. But whether the absorption of the matter be effected or not, the effect of the antiphlogistic treatment on the abscess is in itself useful and salutary; when such treatment of abscess is adopted and steadily followed out, the wall of the abscess is less vascular, less disposed to be excessively distended, the matter is better circumscribed, and when evacuated, the surrounding parts are more susceptible of speedily reuniting. If therefore this plan has been resorted to before any fluctuation is perceptible in the tumour it will not be improper to persevere in it, even after the matter is formed. The propriety of this mode of treatment will be still more obvious, if we suppose a case in which the previous local irritation, being moderate, the progress towards suppuration is slow, and matter is formed in the centre of the tumour, while its circumference presents still an engorged and hard circle. In such a case, the maturation of the abscess, and preparation for its speedy cicatrization, will be best provided for by local depletion, emollients, &c. The original irritation, as well as that still kept up by the presence of pus, and the engorgement of the surrounding tissues, upon which the reaccumulation of the matter so mainly depends, will thus be most efficiently combated. The same reasoning, resting upon the same data, obtains, in relation to the absorption of the matter in the symptomatic abscess; for when in consequence of diseased bone, either in a vertebra, or the articular head of a bone, matter is formed and directed in various courses towards the surface, the abscess is but a complication added to the primitive affection, a consecutive extension of the inflammatory process into new tissues: but if it was deemed proper before the pointing of an abscess in a distant part, that the primitive affection in the vertebræ, or the articulation, should be combated by the insertion of issues on each side of the spinal column, or in the neighbourhood of the joint, by blisters, rest, and the exhibition of internal remedies suited to the constitution of the patient, the formation of the consecutive abscess would form no just ground for departing from a plan of treatment upon which the cure, and the absorption of the matter itself, may ultimately if not wholly depend. The formation of matter, therefore, in a part which is suffering from irritation, which may have been combated by capillary depletion, furnishes no indication against the continuance of such treatment; a counter indication to the practice can only arise from the general state of the patient.

There are two kinds of abscesses which are little or not at all disposed to this sort of termination: the one, the acute and rapidly formed abscess, accompanied with all the inflammatory phenomena in a high degree; collections of this kind quickly point, and either burst, or require evacuation: the other, the chronic abscess with thickened cyst. This condition of tissue must be modified by a different mode of stimulation, before agglutination of the sides of the abscess can take place. In some subjects, who have been enfeebled by disease, or in whom the lymphatic temperament prevails, there appears to be a ready disposition, a diathesis, to the formation of pus. In such cases, the facility with which the pus is resorbed is quite as remarkable as that with which it is formed, and all the secretions concurring in the elimination of the matter, seem, while the process is taking place, to put on a puriform character. A secondary irritation supervening in the secreting surfaces or organs, the slight local irritation which preceded the formation of the matter seems to be extinguished, the collection is dispersed, and the matter is eliminated by the ordinary channels of the economy.

There are, besides, certain circumstances which should have due weight with the surgeon, even when he does not entertain the hope of being ultimately successful in effecting the absorption of the matter; it will not for example be proper to open an abscess, when once the matter is formed, in a person of decided lymphatic or scrofulous habit, without beforehand employing such general and medical treatment, as will usefully modify such constitutions. The evacuation of the matter in these cases is subordinate to the restoration of the vital energies, and will be attended with the best results, only when the general amendment of the patient shall have been fully provided for.

Opening of Abscess and subsequent Dressing.—Let us now suppose that all our efforts to prevent the formation of matter, or to procure its absorption when formed, have been fruitless; the question of the time and mode of opening the abscess naturally arises, and is of considerable importance, as certain abscesses require to be opened before they are matured, while the evacuation of others may be beneficially retarded.

The opening of an abscess is urgent, nay cannot be safely delayed, when it has been produced by the extravasation from their natural reservoirs or channels of the soft or fluid secretions of the body, such as the urine, fæces, blood, tears, saliva, milk, bile, &c. (see URINARY AND STERCORAL ABSCESS.) The termination in such cases is but a mixed state of suppuration and gangrene. The surgeon must quickly prevent the extravasating matter from extending to parts still sound, at the peril of seeing the integrity of those parts, and life itself destroyed. Mention has been already made of the gravity of certain abscesses developed in the walls of the great visceral cavities, in the groin, under the pectoral muscle, and in the vicinity of the great articulations; to these may be added, collections in the neighbourhood of the larynx, pharynx, and trachea, which impede the free functions of respiration and deglutition. When matter is formed under the strong fibro-cellular fascia, behind the sterno-cleido-mastoid muscle, the strength of this fascia is so great, that the matter is pent narrowly up, producing excessive tension and pain, and the pus must fuse under the clavicle, towards the upper part of the chest or axilla. An early evacuation in all such cases is obviously desirable, and even necessary, to save the patient from the danger of irruption into the internal cavities, or from the imminency of suffocation. In the same order we should also class those collections, which, being accompanied with high inflammatory phenomena, are developed rapidly in parts abounding in the adipose and cellular element, such as the vicinity of the rectum, the margin of the anus, the groins, the axillary and popliteal regions, the sides of the neck. Irritation, arising in the cellular tissue, finds every condition favourable to its propagation, and thus is speedily extended; to prevent, therefore, those unlimited denudations, those *suppurative* dissections of parts, an early opening is absolutely indispensable. It is a matter of common remark, that an abscess is slow in pointing externally in proportion to the extent of loose cellular structure in which it is allowed to fuse unopposed. These cases require, in a special manner, to be treated by soothing applications and local depletion.

In so far the conduct of the surgeon is easily dictated; but the indications for early opening may be in the highest degree imperative, while the symptoms are so obscure as to give rise to considerable embarrassment. We have often seen experienced practitioners hesitate in these circumstances, and not unfrequently, upon a too hasty decision, open tumours in which not a drop of pus could be detected. The obscurity in such instances may depend, as has been already stated, upon the matter being deeply-seated, and masked by unyielding aponeurosis, and great circumspection and tact are necessary to enable us to form a right judgment; account should be taken of the degree of the preceding inflammation, the functions that may have been disturbed, as connected either with the supposed seat of the matter, or as appertaining to the constitutional phenomena characteristic of its formation, the doughy condition of the parts, the ill circumscribed state of the tumour, and the fluctuation itself, however obscure, before the incision of the parts is made. These cases occur most commonly in the interstices of the muscles of the thigh, the arm, the fore-arm, the sole of the foot, and in the tendinous sheaths (see Thecal Inflammation); the importance of limiting the ravages, perhaps irreparable, which the pus would make if it remained undiscovered, is sufficiently great to challenge the highest and most careful exercise of patience, tact, and skill the surgeon can bring to the consideration of the case. As soon as the anterior signs, the cellular *empâtement*, and a feeling of fluctuation, though obscure, are all present, he is justified in making his incisions, to prevent the more serious mischief which might arise from delay, although the depth of the matter from the surface may be considerable.

Another motive for the early, and even premature opening of an abscess, will be found in the case where its progress is attended with intolerable pain, great constitutional disturbance, and even convulsions, loss of appetite, sleep, &c., and when, from the nature of the parts abounding with nerves and blood-vessels in connexion with aponeurosis and tendinous sheaths, or the violence of the inflammation, there is excessive tension and danger of strangulation of blood-vessels and nerves, and gangrene (see Anthrax); or when the compression of large vessels, such as the jugular veins, threatens suffocation, or cerebral congestion. In such circumstances the chief consideration is to shield the patient from peril, whatever may be the inopportunity of laying open the collection, as regards the tumour itself; as to wait for the maturation of it might be tantamount to sacrificing the patient's life. In such cases, opening a way for the matter will not be sufficient; the dangerous tension of the parts must be relieved by free incisions.

Much caution is also requisite in the treatment of abscess, formed in visceral organs, contained in the natural cavities of the body, which points externally; for if it be an object to evacuate the pus, it is still more important to prevent the escape of the matter into the cavity in which the suppurating organ is contained; an event which can only be insured by deferring the evacuation until the adhesions, which cut off the communication with the serous cavity, are fully established. The evidences of this adhesion will be found in the active sympathy of the skin with the suppurating organ; it becomes painful, hot, tense, red, and distended, and its centre points.

In general, it may be laid down, that chronic abscesses, with thickened walls, should be opened when, in spite of the previous treatment, they show a disposition to extend; cure by the absorption can no longer be expected, the matter must be evacuated, and the sooner it is done the better.

The opening of congestive or symptomatic abscess does not exactly fall under this general rule. We have said already, that the fatal issue in such cases is in general hastened by the opening, and the admission of air into the cavity of the abscess; at all events, the formidable character of the symptoms and rapidity of their march most commonly date from that period. It is, therefore, desirable, while general treatment is directed to the cause of the disease, that the period of opening should be put off as long as possible. But while we seek to secure this advantage, we must be mindful that we do not obtain it at too great a sacrifice. We should not, through dread of the consequences of opening, defer it until the pus has burrowed to a great distance, and the covering of the abscess becomes so thin, as to threaten an extensive rupture. In this case, opening does not mean entire evacuation. Dupuytren prefers even an early opening, to allowing an unlimited extension of the abscess, and states, on the authority of numerous cases, that an opening may be made in the early stage without any great risk of serious consequences: the opening after some time becomes fistulous, and furnishes a favourable exit for the pus and osseous debris. But the chances of so favourable an issue depend much on the good state of the patient's bodily health, the integrity of the strength and appetite, and the smallness of volume of the abscess.

When he used to treat symptomatic abscess in this manner, he always insisted, in a special manner, that there should be no suspension of the means directed to the cure of the primitive lesion of the vertebræ, or articulations; and this, perhaps, will go far to account for the successes he speaks of.

Modes of opening Abscesses.—When purulent collections occur in the tonsils, pharynx, behind the walls of the œsophagus, of the glottis, and even in the larynx, they may be sometimes evacuated by the use of an emetic, as those occurring in the course of the intestinal canal, particularly near the rectum, may be by the administration of a purgative. When the wall of the abscess is thin upon the mucous membrane of the œsophagus or rectum, the commotion produced by the efforts of vomiting or purging will often suffice to effect the bursting of the abscess; the cure immediately follows. But though many reasons, such as the inaccessibility of the abscess, or the pusillanimity of the patient, may induce us to give a trial to an emetic, in such cases we should, nevertheless, when there is any counter-indication to this plan, arising out of the state of the patient's health,—if there be irritation of the stomach, marked by dryness and redness of the tongue,—it should be most carefully avoided; for this would be but incurring a great risk for an uncertain good. But when the tongue is soft, large, and slightly coated, the mouth and pharynx foul with thick viscid mucus, and there is no sensibility at the epigaster, then there is a prospect of the action of the emetic being followed with good effect. It should be added, that the bursting of abscess in the mouth, pharynx, and rectum, is not unfrequently promoted by gargles and lavements. The emollients in these cases act in the same manner as the maturative, employed in subcutaneous abscess to hasten the arrival of the matter to the surface, by the softening of the skin, and the stimulation of the purulent cyst.

When the suppuration is fully established, and shows a tendency to accumulate rather than to be resorbed, it will be the surgeon's duty to evacuate the matter, and for this purpose several modes may be employed; that by incision being by far the most expeditious, simple, and generally employed.

The instrument most commonly employed for this purpose is a spring-opening bistouri, as it possesses several advantages in respect of solidity and the capability of being wielded, over the abscess lancet, which is now but little used in any case. The mode of performing the operation is very simple (see Incision for a more minute description). The situation in which the opening should be made, as well as the extent and number of them, will vary according to the circumstances of the case; in general, however, they should not be so long or deep as the older surgeons were in the habit of making them; for independently of the deformity of a large cicatrix, the speedy healing of the abscess is rather retarded than hastened by those unnecessarily extensive divisions of the whole superficial paries covering the collection of matter. However, when an abscess is deep-rooted, the incision must of necessity be extensive; the object being in these cases to secure a sufficient opening for the exit of the matter without fear of its closing up too soon.

In general it will be proper, whenever practicable, to make the opening at the most depending part of the collection, in order that its own weight may favour its evacuation. But this will often be impossible; for in some instances an extensive abscess will have ripened and pointed in the centre, while the matter, at its most depending point, is still at a considerable distance from the surface. In such a case, the opening may be made where the abscess has pointed, care being taken when the dressings are changed to prevent lodgment of the matter, by pressing upon its circumference and lower part in particular. When the collection, for due motives, is opened at its thinnest and most prominent, and not at its lowest point, the inconvenience may be remedied to a great extent, when it is possible, by position aided by gentle and gradual compression, making the matter tend towards the opening. But when this cannot be effected, and still more especially when the purulent cavity is irregular, ramifying amongst the resisting parts, thus forming smaller cavities having but narrow connexions with the parent focus, it becomes imperative to make multiplied counter-openings, under the penalty, if neglected, of the retained pus becoming stagnant and decomposed; in which condition it loses all relation, however remote, to the living parts, reacting upon them as dead deleterious matter.

The absorption of this putrescent fluid, differing *toto cœlo* in its qualities from pus, is speedily followed by fever, loss of appetite, diarrhœa, rapid wasting; the sources of nutrition are stopped, and the patient falls into extreme marasm. These counter-openings should be made as soon as the necessity for them is discovered, and should be numerous enough to obviate every impediment to the free exit of the matter. They may be made either by pressing the pus into each of the small cavities, and dividing it with the bistouri, when thus swelled up with matter, or by passing a director or female sound into the superior opening until it reaches the bottom of the cavity, when the wall is divided on the point of the instrument. The effect of this practice is speedily manifested; sleep and appetite return, the system throws off the putrid poison it had been imbibing, and the healing process sets in in the upper abscess.

The dressing after an opening has been made is by no means unimportant. When the irritation is still unabated, it will be highly useful to allow the wound to bleed, and the abscess to unload itself, before any dressing is applied; the walls should not be pressed painfully in order to force the matter out, as this would tend to keep up irritation, and could have no good effect. Whenever the engorgement of the purulent cyst or surrounding parts is considerable, which is always the case when circumstances compel the premature opening of the abscess, the parts should be covered with cataplasms or other emollients. This treatment is principally indicated in the acute abscess.

How opposite our treatment in chronic

and symptomatic abscess! A large opening in the case of a symptomatic abscess would not fail to induce all the bad consequences of the sudden introduction of air within an excitable and extensive cyst. A different mode of opening, namely, by successive small punctures is therefore adopted in such cases. But even here there is some variety in the mode of making the punctures. Some practitioners use a needle, the same as that employed in evacuating anasarcous collections of the limbs, scrotum, &c., or a cataract needle; in the latter case, a cupping glass is placed over the small puncture in order to pump out the matter, at the same time that it prevents the access of the air. In the Hotel-Dieu of Paris, the puncture is made with a thin-bladed bistouri. The skin is drawn on one side so as to be rendered tense in the part where the puncture is to be made; the retraction of the skin is kept up until the quantity of matter desired is evacuated; it is then relaxed, and, regaining its natural position, the opening made in it no longer corresponds with that of the cyst. By this method the jet of pus is of tolerable volume, and can be stopped as soon as the bulk of the tumour has fallen a little. The period for repeating the puncture will depend on the rapidity with which the pus is exhaled; the proper time will be when the tumour has again become tense. It is important when the matter has been drawn off, that the little orifice shall be properly closed: the adhesive plaister used for this purpose should be fresh and good, and should be placed double on the opening; and once placed it should not be removed, but rather be allowed to fall off. It will contribute much to a favourable issue, if the air can be perfectly excluded, or admitted only in such small quantities as gradually to accustom the interior of the cyst to its presence. It will happen upon the first, second, or third puncture that the cyst becomes irritated, painful, and tense, accompanied with constitutional disturbance, colic, diarrhœa, and vomiting; but these symptoms are much less intense and obstinate than when the air has been suddenly and largely admitted; they soon yield to proper treatment, local and general, and become less and less manifest at each successive puncture. While this is taking place, the maintenance of the general health, the gradual diminution of the tumour at each successive puncture, and the progress of amelioration in the primitive lesion, inspire hope of a favourable termination. Sooner or later, however, whether we have to deal with a large chronic abscess or a symptomatic collection, the period arrives when the small orifice resulting from the puncture will not heal; it remains open, and is often enlarged by breaking into one or more of the preceding ones. The advantage of the treatment by successive punctures will then be evident. Had they been delayed till the collection thinned the surface and burst extensively, the symptoms of reaction consequent upon the free admission of air would not only be intense, but in all probability incontrollable for the future; but thus in a manner habituated to, and prepared for its impression, the walls of the cyst are less susceptible of a high and baneful excitement, and the constitution of the patient is not perilled so much by the suddenness and severity of the shock. Nor is this all; for as the procession of the symptoms is hereby checked, there is time to combat for success against the constitutional lesion in which the abscess originated. This method receives extensive application in the French hospitals, being preferred in cases of empyema and other analogous collections, as well as in that of symptomatic abscess. Purulent collections are also sometimes evacuated by passing a seton through the tumour which they form; and this with a view to the slow evacuation of the fluid, as well as to excite a healthy action in the walls of the cyst. The practice is grounded on the notion that the *mèche* introduced into the wound permits a capillary oozing out, of the pus, while its volume prevents any sudden or considerable flow of it: but this will be the case for a short time only. The engorgement of the small orifices occupied by the *mèche* soon subsides, and the matter escapes continually and without further check; the *mèche* soon comes into painful contact with the lining membrane of the abscess which it irritates and thus retards, or opposes the cicatrization of the cavity. The operation itself, as well as the subsequent dressings, are besides very painful, while the treatment is more protracted, and the cure is not more certain than by incision.

In some rare cases, it may be necessary to employ a trephine to liberate the matter of an abscess. M. Roux relates a case in which a collection of matter within the cranium was indicated by an external abscess, which communicated with it through a perforation of the bones of the skull; this may happen, according to this surgeon, whether the primitive collection has been formed between the cranium and dura mater, or whether it is circumscribed in the cavity of the arachnoid. The patient, upon whom M. Roux applied the trephine with success, was seventeen years old; the abscess of the arachnoid had existed four years, under the right parietal bone, and communicated externally through an ulceration in the dura mater, and an opening in the parietal bone: there was a fistulous opening of the soft parts. In this case, however, it should be remarked, that M. Roux had not to contend with the obscurity and uncertainty of diagnosis which commonly exist in cases of abscess within the cranium, (see Head, Trephine,) and which must forbid the practice. The application of the trephine may be also required in cases of abscess of the mediastinum. Matter formed in the mass of cellular tissue, between the cavities of the pleura, will not only betray its presence by fever, and wasting, and by the impediment it creates to the functions of the heart and lungs, but also by its working out at the sides or inferior part of the sternum, wearing its way through the bone itself. But the pus must have actually shown itself, before we should resort to the application of the trephine; the mere rational signs, such as the dull sound under the sternum, the dyspnœa, the doughy condition of the integuments, the hectic fever, nightly sweats, and other symptoms indicative of internal irritation will not be sufficient, because they may be characteristic of very different affections. Another mode of opening is that by caustic; the necessity for employing it arises from particular conditions connected with the origin, the situation, or the state of the purulent collection. In the case of an abscess, originating in an organ contained in the splanchnic cavities, and pointing externally, if the integument be not sufficiently inflamed to satisfy us that adhesion has been firmly established between it and the serous membrane, the opening should not be attempted by any other mode. These observations apply more especially to certain abscesses of the liver and gall bladder. When the caustic is applied, and the adhesions are not sufficiently organized, the inflammation it excites hastens and completes the process of their formation, so that before it bursts forth, there is no longer any thing to be apprehended from the extravasation of the matter into the cavity. (See Abdomen.)

In certain glandular inflammations of the groin and axilla, when the whole tumour is completely softened, and the skin seems to have lost the support of the subjacent cellular tissue to a great extent, it is often advisable to open the collection by means of caustic; this method is adopted in the case of venereal bubo at the Hôpital des Vénériens in Paris. In the chronic abscess of limited extent, the practice is also advantageous. The caustic generally employed is the potassa fusa applied in small quantities over the abscess, in the same manner and with the same precaution to prevent its spreading, as in the case of the insertion of an issue. (See Caustics.) The time during which the caustic remains applied, and the quantity of the caustic must be according to the extent of opening desired, and the expedition with which it is deemed advisable to empty the collection. In the case of the small chronic abscesses, accompanied by feeble marks of inflammation, it will be proper to wait for the matter till the eschar drops off of itself; in the meanwhile, it determines a salutary irritation in the purulent sac, which is much more disposed to cicatrize as soon as it is emptied, than it would otherwise have been. The same mode of irritation is attended with similar good effect when excited in the skin, which has been so thinned by the progress of the abscess as to be almost entirely deprived of its nutrient vessels. In these cases when incision is had recourse to, the thin skin often perishes, or refuses to cicatrize with the bottom of the tumour, and the surgeon is obliged to remove it, by painful resection, followed by tedious suppuration before the wound can be cicatrized, and when cicatrization takes place the scars are unsightly. (See Cicatrix.)

Sometimes the persistence of the suppuration, and the impossibility of healing an abscess, depends on the irritation of a foreign body pent up in the suppurating cavity. It should be sought for and immediately extracted. In other cases, the wasting of the patient is so great, that surfaces, otherwise sufficiently disposed to unite, continue their suppurative action from mere absence of contact, or from the immobility of the parts with which they are connected. Instances are seen in the fistulous openings which are thus kept up in the popliteal and axillary regions, at the margin of the anus, &c.: the cure here is promoted by generous diet, good air, moderate exercise, &c. Suppuration is often sustained solely in consequence of a cachectic, or general bad state of the patient. In persons of lymphatic or scorbutic habits, or who have suffered from long continued mercurial action, the respiration of deleterious gases, &c., suppurative action is easily excited in a wound, and prolonged without any appreciable cause. In these cases, the suppuration itself is of little importance, and the cure is best effected by such hygeienic and medical management as is best calculated to remedy the particular organic vitiation, on which the persistence of the suppuration depends. The whole organism must be healthily modified, before we can excite it to the formation of those adhesions of which it seems to be incapable, and upon which the cure depends.

But whether the opening of an abscess takes place spontaneously, or by one of the artificial modes above alluded to, the subsequent treatment is very simple. True, it may be advisable to enlarge the spontaneous opening when too small, but the treatment in either case will be the same; and not taking account of lesions of remote and important organs upon which an abscess may depend, the local treatment consists only of cleanliness, and the free exit of the matter. The duty of the surgeon now is to provide for the gradual evacuation of the matter, and the successive approximation of the walls of the cavity in which it had been formed; the agglutination of the lips of the wound or orifice must therefore be prevented; this is done by the insertion of a small pledget of lint smeared with simple ointment: it however should not plug up the opening, but be loose enough to permit the gradual escape of the matter. If on the other hand, the sides of the orifice remain parted from each other, the dressings may be flat, and so arranged as to afford a certain degree of support, which may be gradually accommodated to the diminution of the cavity until it at last becomes so wholly compressive as to hasten the cicatrization in a remarkable manner.

Such are the general rules which will be found applicable in the treatment of purulent collections; the particular rules to be observed in the management of local abscesses will be found under their respective heads.

It will be now necessary to notice certain abscesses occurring in particular situations, for which no distinct place is set apart in this work.

We stated at the outset that purulent effusions in the natural cavities did not come within the strict sense of our definition of the word abscess. But purulent collections are formed in the natural cavities, whether mucous, serous, or articular, and in such a manner as to present all the true characters of abscess. There is a striking difference between the matter of those effusions which take place in serous cavities, and that of an abscess properly so called. The nature of the fluid is different from that of true pus, and seems to be composed of serum, mixed up and made yellow by coagulable lymph, or the matter of false membranes (see Empyema). In the case of the true abscess, the cavity is far from being co-extensive with the general cavity in which it happens to be formed; the collection occupies but a limited portion of the cavity, being circumscribed by adhesions, or membranous partitions whereby the isolation of the matter is as perfect as that of an abscess developed in the cellular tissue alone. Treating of purulent collections developed in these situations, it is merely for the convenience of phraseology, that they are spoken of as being formed in the natural cavities, for the cavity in which the pus is formed does not belong to the natural one, having been cut off from it by the adhesive process.

Abscess in serous membranes.—In serous membranes the formation of matter is always partial, owing to the rapid production of the adhesions above-mentioned. Abscesses of this kind are formed frequently in the pleura, peritoneum (see Abdomen), and in the arachnoid. Matter confined in the pleura may be evacuated, either by the corresponding surface of the thorax, through the intercostal spaces; or internally through the substance of the lung, until it is evacuated by the bronchi; those of the peritoneum, through the abdominal walls, or through the intestinal canal; and mention has been made of a case in a preceding part of this article, in which the pus made its way through the bones of the cranium. (See Head.)

Abscesses in mucous cavities.—Abscesses may be formed in the walls of mucous cavities, as in the stomach, bladder, &c.; but they are far from favouring, to an equal extent, as the serous membranes, the formation of the small, limited, purulent focus. When, however, the outlet of a mucous cavity is small, or obstructed, it may not only become the seat of an abundant muco-purulent secretion, but even of the true abscess. We have examples of this mode of suppuration in the maxillary and frontal sinuses (see Ozæna), in the cavity of the tympanum (see Ottitis), in the mastoid, and ethmoid cells, and sometimes in the lachrymal sac.

Various denominations, according to the situations of abscesses, will be found in authors; such as *empyema*, when in the pleura, *vomica*, in the substance of the lungs, *hypopyon*, in the anterior chamber of the eye, *panaris*, in the fingers, *bubo*, in the groin, &c.

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(Wm. B. Costello.)

ACANTHABOLOS, from *ἄκανθα*, a "spine," and *βάλλειν*, "to cast out," a kind of forceps used to extract extraneous bodies from the windpipe, from any cavity, or from wounds. It is mentioned by Paulus Ægínetus; Fabricius, ab Aquapendente, and has been described by Scultetus.

ACCIDENT, *accidens*, Lat., *Zufall.* G. in its ordinary and extended acceptation, means any fortuitous, or unforeseen occurrence. The progress of pathology in the hands of our laborious neighbours, the French, has given a new and more limited value to this word. In their works, it signifies, in a general manner, symptoms, or *ephinomena*. It is used chiefly, though not exclusively, to designate symptoms of an unexpected kind, which occur in, and disturb the usual course of a disease.

ACCIPITER, *épervier*, Fr., *ἱέραξ*, 'the hawk;' a bandage applied over the nose; so called from its resemblance to the claw of the hawk. It is figured in Galen, and others of the older writers. It resembles the T bandage described under the head *Confining bandage*, and which is designed for the same purpose. (See Bandage.)

ACCOUCHEMENT, lying-in. (See Parturition.)

ACEPHALOCYST, from *α*, and *κεφαλὴ*, head, and *κύστις*, bladder: a bladder without a head. (See Hydatid.)

ACETUM, Lat., *ὀξὺς*, Gr., *vinaigre*, Fr., *Essig*, Ger., *vinegar*, Eng.—It is obtained from the distillation of wood; or, in a state of concentration, by decomposing an acetate, and receiving the acetic acid by distillation. In this state it is highly volatile. It has been used by Bonvoisin, in Italy, as a vesicant, and rubefacient, and in cases of sudden inflammation, such as croup, where expedition is an object, it affords a valuable resource for producing almost instantaneous vesication. For this purpose it is applied, by means of blotting-paper, or fine cambric. The vapour of concentrated vinegar, being highly stimulant, is used to the nostrils in head-ache, languor, fainting, and asphyxia. When employed for this purpose, its pungency is moderated by the addition of a small quantity of powdered sulphate of potass, sufficient to moisten the salt. To neglect this precaution would expose the person smelling the pure acid to high inflammation of the mucous membrane of the nostrils and of the frontal and maxillary sinuses. It is successfully employed as a caustic in destroying warts, and other indolent growths from the epiderm. Several acids are employed in surgery, of the properties of which we shall speak under the names of the bases to which they are united. Acetic acid forms the basis of oxycrat. Diluted with water, it is often useful in checking an inflammation which threatens to supervene from blows, falls, and sprains.

ACHILLIS TENDO, *funis Hippocratis*, Lat.; *tendon d'Achille*, Fr.; *Achillesflechse*, Ger. The strong flat tendon common to the gastrocnemii muscles, which is inserted into the os calcis. It is generally well developed in dancers, and good pedestrians. It derives its name from Achilles, who was wounded in this part at the siege of Troy; this tendon was, according to Homer, the only vulnerable part of the warrior's body, he having been dipped, by his mother Thetis, in the river Styx. The tendo Achillis is sometimes ruptured. (See Tendons, rupture of.)

ACIA, from ἀκή, a point. Commentators are not agreed as to the exact sense in which this word was employed by the ancients. According to some, it meant the needle, or the thread, and to others, a particular kind of suture; "*acia mollis, non nimis torta.*"

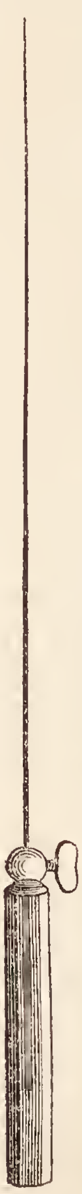
ACOLOGY, a term employed by some German writers to designate that branch of surgery which treats of surgical instruments. (See Instruments, Surgical.)

ACTUAL CAUTERY. The term 'actual' means that which acts suddenly, or instantaneously. The words, 'actual cautery,' are applied to iron at a red or white heat, or to heated liquids, and contradistinguishes this mode of cauterizing from the 'potential,' or virtual, which is not immediate in its action. (See Caustics, Cauterization.)

ACUPUNCTURE (from *acus*, a needle, and *punctura* puncture) is a medico-chirurgical operation, which consists in the introduction of needles, to be hereafter described, into many different parts of the body. Acupuncture has been practised from time immemorial amongst the Chinese and Japanese, from whom it was introduced into Europe a century and a half ago by Ten-Rhyne, a medical officer in the Dutch East India Company's service, and who had resided some time in Japan. Mention of it first occurs in the medical literature of Europe, in a *Thesis de Arthritide*, published by him in London, in 1693. Additional information on the subject was contributed by Kœmpfer, in his *Amœnitates Exoticæ*, in 1712. It was again noticed by Dujardin, in his *Histoire de la Chirurgie*, in 1774, and by Vicq D'Azyr, in the *Encyclopédie Méthodique*, who speaks of it, among other means of irritating or stimulating, "as capable of calming violent spasms, and restoring sensibility in organs, in which this function is weakened." Notwithstanding, it did not obtain any credit as a therapeutic agent, till Berlioz made trial of it in 1810, in cases of neuralgy; and made known the results to the Academy of Medicine. His views respecting the value of acupuncture, with several cases in which it was successfully employed, are recorded in his work on *Chronic Diseases, &c.*, published in 1816, at Paris.

No one, however, seemed as yet prepared to adopt the recommendation of Berlioz. Some years after, Dr. Haime of Tours, into whose hands an account of Berlioz's cases had fallen, and Bretonneau, about the same time, made numerous trials of its safety and efficacy. Haime's cases were published in 1819, in the *Journal Universel*. In England, Mr. Scott, of Westminster, and Mr. Churchill employed it; the former published his results, and a short account of the mode of performing it, in 1821. Hitherto, however, it has been more extensively employed by M. Jules Cloquet, than by any other practitioner; his views on the subject, have been published by Dr. Dantu, one of his pupils, at the Hôpital St. Louis. In St. Thomas's Hospital, I have applied it extensively in cases of rheumatism; the results were published in the fourteenth volume of the *Medico-Chirurgical Transactions.*

The needles employed should be very slender, and sharp-pointed, and furnished with a head of ivory, metal, or sealing-wax. The Japanese supply them with handles. Those employed in Paris have handles that can be fastened to, or removed from the blunt end at pleasure; and this is a good mode of arrangement, as one handle will be thus sufficient for any number of needles. The handle is not only useful for the introduction of the needle, but also, when the thickness is not increased at the blunt end, for preventing it from sinking altogether into the soft parts,—a circumstance which has sometimes occurred, without, however, being productive of bad consequences. The needles employed in Europe have been made of steel, varying from one to four or five inches in length from the handle; those of the Japanese are invariably of fine gold or silver; and their manufacture is conducted only by a few persons, who obtain the emperor's privilege for the purpose. The operation itself constitutes a special occupation in the East: the points at which it is deemed proper, according to the nature of the disease, to plunge the needles, are marked by dots or lines on pasteboard puppets, called *Tsoe-bosi*, which are hung out as signs over the operators' shops. They serve as guides for the application, either of moxa or acupuncture; red dots indicating the proper place for the moxa, green ones for the punctures. The situation of these dots does not seem to have been arranged with reference to the large arterial or nervous trunks, as will appear from inspection of one of these dolls now in the museum of the faculty of medicine of Paris. One of the chief places of election is the middle of the space between the umbilic and the pit of the stomach. Most commonly, the operation is performed in this situation by pricking or puncturing nine punctures, ranged three by three in parallel lines, about half



an inch asunder. It is stated that they are so bold in the application of the needles, that they plunge them into the various viscera, and even into the fœtus in the womb, to repress its tumultuous movements; but they avoid carefully puncturing in the neighbourhood of the articulations. Moxa and acupuncture are held in high estimation by them, and, indeed, may be said to constitute the whole of their practice of surgery; acupuncture, in particular, is as universally employed, and in as great a variety of cases as bleeding, which they abhor, is with us. But they have the most unbounded faith in its efficacy, when indicated by pains which they suppose to depend on winds or vapours wandering about, or pent up in various parts of the body. The selection of the part, however, is not, except in cases where poor persons trust to their own experience, left to the guidance of the indications on the lay figure. The seat of the pain, if varying from them, sets aside their value, and whichever operation is to be performed, particular persons are consulted; these are called *Tensasi* touchers, or searchers of the parts, and *Faritatte*, the needle-prickers or operators.

The introduction of the needles is effected either by smartly pricking the skin, and pressing onwards, while the operator rotates the needle, or by a blow of a small mallet. Since the adoption of acupuncture by scientific practitioners, the following mode is preferred:—the spot being selected, usually the seat of pain, or when any circumstance forbids this, the adjacent parts, the operator having stretched the skin with the fore and middle fingers of the left hand, pierces it perpendicularly with a gentle pressure, and the body of the needle is advanced by means of a semi-rotatory motion, in opposite directions, till it has penetrated to the required depth; and this is repeated till the desired number is introduced. Their withdrawal is sometimes effected by means of a forceps; but it will be better to withdraw them by the same motion with which they were introduced, as the skin is painfully elevated by their direct and forcible retraction; possibly, also, by the latter mode, the point of the needle might be broken off, if it were not well tempered. The withdrawal of the needle is not followed by hæmorrhage, but sometimes a single drop of blood oózes from the puncture. In penetrating, the needle often meets with variable degrees of resistance, according to the nature of the parts through which it passes. The Japanese and Chinese allow the needles to remain only while the patient makes thirty respirations. M. Cloquet states, that he derived the most marked benefit in cases where he caused them to be kept in several days; this accords with my own experience. It is true, the pain may cease instantaneously on the introduction of the first needle; but we observe this by far more frequently after the needles have been in some time; indeed, so satisfied am I on this point, that I prefer a single needle remaining for some time in the part, to several introduced and withdrawn speedily. But there is yet no general rule as to the time which the needles ought to be allowed to remain. Dr. Bache, who has employed acupuncture successfully in America, in cases of rheumatism, states, the more chronic or long standing the disease, the greater will be the length of time the needles should remain in the tissues. Practitioners who are best acquainted with the mode of performing the operation, object to forcing the needle in by sudden and direct plunging,—the tissues on its route are thus wounded; whereas, they maintain, when the needle is gently rotated, that the fibres are only separated. In general, the pain of introduction is so slight as to be entirely disregarded; as a proof of this, it may be mentioned, when M. Cloquet drew the attention of the profession to acupuncture, in Paris, it was by no means uncommon to see the students bare the calves of their legs, and insert common pins into the substance of the muscles, to convince the incredulous of the innocuity of the operation. Sometimes, however, the progress of the needle is marked by sudden and severe pain. M. Cloquet describes the pain as bearing some analogy to an electric shock. M. Dantu has made the same observation [1]. After the needle has been a short time introduced, it produces a sensation of pricking, heat, and in some instances of cold and numbness; it is surrounded also by an areola, more or less vivid. Beclard saw one case in which the introduction of a needle into the leg to soothe acute pain, was followed by fainting and delirium. From the impression which it made on his mind, he felt disposed to reject the operation altogether. Fainting, however, must be of rare occurrence. M. Cloquet did not observe it oftener than once in thirty times in the thousands of cases in which it was employed at St. Louis. In upwards of fifty cases in which Dr. Bache employed the needles, he did not observe a disposition to swooning in more than one case; in which, however, syncope did not take place, and in no case was any untoward consequence observed. Care should be taken to have the needles perfectly polished before using them, as the pain of introducing one that is quite smooth will be comparatively slight; for this purpose, they should be passed into the emery bag both before and after use.

Therapeutical applications.—The boldness of some experimenters on acupuncture has been to the extent not only of exciting wonder but disapprobation on the ground of temerity. M. Samuel Cooper, in the article Acupuncture, in the Surgical Dictionary, observes, "In a modern French work (Berlioz's), it has been highly commended; but the author sets so rash an example, and is so wild in his expectations of what may be done by the thrust of a needle, that the tenour of his observations will not meet many approvers. For instance, in one case, he ventured to pierce the epigastric region so deeply, that *the coats of the stomach were supposed to have been perforated: this was done for the cure of an obstinate cough, and is alleged to have effected a cure!* But, if this be not enough to excite wonder, I am sure the author's suggestion, *to run a long needle into the right ventricle of the heart* in cases of asphyxia, must create that sensation." Yet, though I am far from recommending the practice, it is nevertheless certain, that most of the viscera of the great cavities have been occasionally penetrated in the human subject. without the least inconvenience. Cloquet, Velpeau, and Dantu, have shown that the arteries, nerves, and principal viscera, may be punctured with fine needles, without producing any serious effect.

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[1] When the needle is of an oxydable metal, a galvanic current issues from it, which is recognised by the galvanic multiplier of *Schweigger*. But this circumstance does not appear to have any influence on the efficacy of acupuncture, which is equally successful, when the needles are of gold, silver, or platina.

Bretonneau has unhesitatingly introduced needles into the brachial and radial arteries in his own person, and into the brain, heart, lungs, and stomach of puppies, apparently without producing pain, or any perceptible injury or inconvenience. The innocuity of acupuncture may therefore be considered as established. But so much cannot be said for the certainty of its curative effects. The cases in which it has been most frequently observed to be successful are various painful affections, independent alike of active inflammation, or organic disease ; in muscular and neuralgic rheumatism, unaccompanied by heat ; in sciatica, lumbago, hemicrania, supra-orbital, temporal and facial neuralgies. It has been resorted to in muscular pains arising from strains and contusions, cramps, and uterine pains. M. Haime employed it successfully in a case of hiccup, which had long resisted the various usually indicated remedies. The general opinion of those who have observed its effects is, that it may be resorted to with prospect of benefit in diseases involving derangement of sensation and motion. M. Trouvé, of the Hospital of Caen, in a case of hysteria, accompanied with stiffness and drawing up of the inferior extremities, in a young woman, was successful in removing, in the space of three hours, the shortening of the limbs, and, at the same time, the severe pain in the loins, by means of four needles thrust into the lumbar region. Three days after, another attack of hysteria, which threatened, was averted by the introduction of six needles in the cervical region ; the same success was obtained in this case on several subsequent occasions, until the hysteria entirely disappeared. He relates another case in which relief was given in a case of paralysis of seven years' standing, which was produced by a fall on the back. (*Dict. de Méd.*)

Dr. M'Braire, of the London Hospital, has recorded in the *Medical Gazette*[1], a case of paralysis of the upper extremities caused by taking cold while the patient was under salivation, which was relieved by the use of the needles. Dr. Carraro has made some ingenious and successful experiments with the needles in the cases of asphyxia of kittens. The animals were plunged in water till all appearance of life became extinct ; the action of the heart was restored, and life renewed by passing needles through it.

The success attending the application of the needles has, however, been most remarkable in rheumatism. Of a hundred and twenty-nine cases treated by Cloquet, about eighty-five were cured. Of thirty-four published by others, twenty-eight were cured. Of forty-two cases taken in succession as they stood in the hospital books, thirty were found to have been cured, and the remaining twelve were not proper cases for the success of the remedy, there being much heat of the affected parts. Dr. Bache has had a number of similar cases, of which the great majority were cured by acupuncture ; but he observed, that it is much less successful in neuralgia. It is not uncommon to observe the pain of rheumatism or neuralgia shifting its seat on the application of the needles, and yielding entirely on their reapplication in the new situation the pains have shown themselves.

Amongst the means recently proposed to replace the use of ligatures for stopping hæmorrhage, puncturing the arteries with needles has been mentioned, though not with the same degree of confidence, or chance of success, as torsion. Bretonneau found in some instances that the transfixed vessel became blocked up with a coagulum, and finally impervious. M. Velpeau, his distinguished pupil, renewed and extended those observations in 1830, at the end of which year he read a paper on acupuncture as a means of obliterating the artery in cases of aneurism, before the Academy of Sciences. His object seems to have been to excite inflammation of the coats of the artery by the puncture ; while the needle being allowed to remain in the vessel, a mechanical obstacle would be presented to the blood, upon which it might readily coagulate. In the experiments made by Velpeau on animals, in all cases in which the needle remained three days, the transfixed artery, he says, was found obliterated. But the depôt of fibrin, by which the artery is rendered impervious, is by no means a certain result of the puncture, even though the pins be allowed to remain four days in the vessel. But, supposing it to occur constantly, it would still be a question whether it was superior to the ligature, as in either case, the vessel must be denuded. If the artery could be transfixed with certainty, without disturbing the parts in which it is embedded, it might be entitled to higher consideration, as we should thus avoid the danger of making large wounds of the soft parts, in which subsequent inflammation often destroys the expected effect of the best-executed operation. M. Velpeau has not thought proper to make application of acupuncture for the cure of aneurism in his own hospital, a fact which it may not be unfair to take as evidence of his own opinion of its value.

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[1] 1831. Vol. vii. p. 607.

Acupuncture has been very recently employed with success in the cure of hydrocele. In this process, the needle is used instead of the trocar, and the *palliative* is converted into the *radical* cure. This new application of acupuncture originated with Mr. Lewis, and is described by Mr. T. King, in the first number of the *British Annals of Medicine*, January, 1837[1]. A needle is passed through the skin, dartos, and cremaster, into the distended tunica vaginalis; as soon as it is withdrawn, a drop of the fluid exudes, and shows itself, like a tear, on the integuments. "The appearance of a drop of the fluid," says Mr. King, "at the top of the little wound, is the test of the operation being well performed; it shows that the bag is perforated, and that its contents can find their way out."

The needle, on being withdrawn should be rotated, as the success of the process depends upon the means afforded by the puncture, for the fluid being extravasated into the surrounding cellular tissue. In the space of twenty-four or forty-eight hours, the whole of the fluid is thus transferred from the cavity of the tunica vaginalis into the cellular tissue, the extent of the infiltration of the scrotum being in proportion to the quantity contained in the natural sac. The fluid is absorbed in the course of four or five days, and a permanent cure is thus effected. Upon the complete evacuation of the fluid, the tunica vaginalis is restored to its normal condition, and this is one of its advantages over the other modes of curing hydrocele, by inducing adhesion between the opposite surfaces of this serous cavity. Mr. Lewis has found this mode of treatment successful in every case of hydrocele in which he employed it. Acupuncture, merely as a palliative cure for hydrocele, would doubtless be a very great improvement; but how much more valuable does it not become, when we find it a safe, easy, and almost painless mode of remedying this troublesome affection? Some doubt may perhaps be entertained of its being sufficient to prevent the reaccumulation of the fluid in cases where the distension of the tunica vaginalis has been very considerable. But even should the fluid be again secreted, its evacuation, by successive punctures, will soon render the serous cavity so small, that success will be as easily attained as in a case of recent formation.

Acupuncture is advantageously employed in evacuating the serum in anasarcous limbs, and for this purpose is much to be preferred to the lancet, the punctures of which, when the habit is greatly debilitated, are liable to become sloughy; it answers well also in œdema of the scrotum, penis, eyelids, &c.; it has been employed with the same view in congenital hydrocephalus; it is also used sometimes in exploring the nature of deep-seated tumours, collections of pus, &c.

Acupuncture, associated with electricity and galvanism, under the name of electro, or galvano-puncture, has also been employed by Berlioz and Sarlandière: it merely consists in establishing a communication between the needles and the conductor of an electrical machine. M. Leroy d'Etiolles has proposed galvano-puncture in strangulated hernia; he hopes to reduce the intestine by inducing sudden contraction of it in the hernial sac; his views are supported by the favourable results of some experiments on animals. M. Majendie has also employed galvano-puncture in cases of complete and incomplete amaurosis; successfully in some of the latter.

Various theories have been proposed to explain the action of the needles. The Japanese believe that all diseases depend upon hurtful winds or vapours pent up in the organs of the body, and that acupuncture procures relief by giving them vent. Amongst scientific investigators, some suppose its effects to depend on derivation, others on some special influence, resembling the action of electricity. The nervous fluid has also been resorted to, to clear up the difficulty. Haime and Cloquet imagine that nervous pains depend on an accumulation of the nervous fluid in particular parts, and that the presence of the needles gives relief by equalizing its distribution. Dr. Bache adopts this opinion, and conjectures that the accumulation of the nervous (electrical?) fluid is favoured by an altered state of the fasciæ, whereby they are rendered capable of isolating the parts which they surround. No proof, however, is adduced that such is the fact.

It is not difficult to explain the indifference that has been shown to the extensive adoption of acupuncture; there is, in general, some disinclination manifested for the employment of a remedial agent, of which the action, or *modus operandi*, cannot be in some way connected, analogically, or otherwise, with that of the remedies which common use and universal experience have sanctioned. The effects of acupuncture are not deducible from counter-stimulation, for they are sometimes most remarkable when such stimulation has been scarcely felt,—nor from electrical agency, for they are equally produced when the needles employed are of gold or silver,—nor from moral agency, for they who deride the curative influence of the needles are as much benefited by their application, provided their cases be suitable, as those who have the most unlimited confidence in their efficacy; the reasoning and incredulous European, being in this respect on a level with the all-believing and unlettered Chinese. And yet these effects are not only beyond all dispute, but in many instances are so prompt, so marked by cessation of pain, as to impress the vulgar mind with the idea of supernatural agency. The differences of opinion respecting the value of acupuncture are the very opposites of each other, and are entertained by two classes of practitioners: the one indifferent, deeming its importance so problematical, so improbable, that investigation of its merits would be a waste of time; the other, enthusiastic, being satisfied from observation and experience, that many owe their deliverance from pain to the prolonged or frequent application of the needles, who had sought relief in vain from the adoption, and long perseverance in the use of other means. For our own parts, fully convinced of its importance in therapeutics, we should merely recommend that greater attention be bestowed in observing the cases in which it is found beneficial, in order to enable us to point out with greater precision, those in which it is suitable.

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[1] Mr. Travers has been in the habit of treating hydrocele for the last two or three years, both in hospital and private practice, by a nearly similar process. He does not, however, state the result as invariably successful. (See HYDROCELE.)—ED.

(*John Elliotson.*)

ADHESION, *adhæsio*, Lat., προσφυσις Gr., *adhésion, adhérence*, Fr., *Anwachsung, die Anhänglichkeit*, Ger., *conjungioni, aderenze*, Ital.

The term *adhesion* is applied in a general sense to the accidental, or abnormal union of parts, whether in consequence of a primitive arrangement of the organization itself, or of inflammation, producing the continuity of parts that are naturally unconnected, or artificially separated: in a more limited sense, that in which it is emphatically surgical, it designates the act or condition of union, between the sides of any preternatural solution of continuity. The French pathologists sometimes employ the word *adhésion* to denote the act, and *adhérence* the state of union. We shall notice in this article the adhesions, essentially reparative, that nature establishes between the different portions of membranes naturally free, that line the visceral, mucous, or synovial cavities, as well as those accidental adhesions which impede the functions of organs.

In a living organism, whose relations with the external world are innumerable, the power of sustainment alone, if it could be conceived, independent of that of reparation, would be obviously insufficient; and the first lesion of its integrity would involve necessarily the destruction of the whole. The designs of Nature would be frustrated; as few, if any, of the multitudes of living beings that exist, could ever reach maturity. Accordingly, in the study of organization we find that this reparative power, with its appropriate element, cellular tissue, is largely bestowed. The history of cellular tissue alone comprises, not only that of the production of adhesions in general, but of every other tissue of the body. It is not improbable, that the closest relation exists, from the most rudimentary state of the being to the latest period of existence, between the quantity of the cellular element and the intensity of the productive power.

In the first stages of human fœtal life, when the formative power displays such rapid and wonderful changes in the development of form and structure, the cellular or coagulable element may be said to be the only one that can be recognised, the matrix in which all the organs are successively moulded. In the adult, the power of producing organs has ceased as to the individual, being entirely diverted to a single function, that of the reproduction of the species; the cellular element has diminished in proportion to the organs that have been founded and produced in it, and its function now is simply reparative. In old age, the hard structures tend to predominate, the cellular tissue gradually diminishes, till the reparative power is totally extinguished, and death takes place.

This fact of reparation must have been amongst the earliest recognised by physiologists, and of course the mode in which it is effected must have been an object of investigation at a very remote period. Galen in some part of his works, in speaking of wounds, has bequeathed the very phrase which at this day is used to designate one of their modes of union, namely, *that by first intention.* The subject, however, had received but little useful investigation until the great Hunter turned his attention to it. He devoted thirty years of his life to the study of inflammation in its symptoms and effects upon the various tissues, and by thus tracing out a clear path in which the pathologist enjoys the advantage of his mighty labours, he founded a new era in the science, no less glorious for his country, and advantageous for humanity, than the discoveries of Harvey and Jenner.

Adhesion takes place between various parts of the fœtus in the womb; it is then termed congenital, and presents to us the imperforate conditions of the anus, vagina, eyelids, nose, mouth, &c. It occurs between the surfaces of parts, naturally free, when the conditions that produce it are present, and the parts are in contact, as between the costal and pulmonic pleuræ, the visceral and parietal folds of the peritoneum, the heart, and pericardium, &c., and between the surfaces of recent wounds when brought into contact, or so nearly so that the small space may be filled by a coagulable matter that soon exudes from the wounded surfaces. In this last sense, adhesion is eminently sanatory, and furnishes a broad basis whereon to rear up the noblest enterprises of surgery, constituting a large portion of its highest achievements, whether curative or operative.

Although the study of adhesion, inasmuch as it relates to surgery, may be chiefly confined to lesions produced by accident or art, on external parts, it will, nevertheless, be proper, in order to a clear understanding of all its phenomena, to consider adhesion, in whatever situation, and in whatever manner, it may be produced.

We shall first consider adhesion in its simplest form; namely, as occurring between the clean surfaces of an incised wound, in which, as Hunter expresses it, "the operations of restoration arise naturally out of the wound itself, which having been made in healthy parts, both the disposition and the means of cure are present." After the blood ceases to flow, a small portion may be retained upon the divided surfaces, which coagulates; when the lips in this state are brought together, a reddish lymph soon begins to exude, and an action is set up, during which the lips of the solutions of continuity become agglutinated. This lymph, to which Hunter gave the name of *coagulating*, is, according to the recent researches of Lassaigne, not albuminous, as has been hitherto imagined, but composed of the fibrine of the blood, in which new vessels are soon developed, by which the circulation and continuity of the divided parts are restored. As to this point, therefore, these researches are so far important as to remove a difference of opinion which prevailed between Hunter and Thomson. Hunter believed, that the bond of union might be produced in three ways:—1. by exudation of blood, when the quantity was not too great; 2. by the extravasation of coagulable lymph; and 3. by granulations. Thomson and others doubted the correctness of Hunter's opinion, as to the blood becoming the bond of union; but now that we know that coagulable lymph is fibrine, the colouring-matter of the blood being removed by a vital process, the body of the controversy disappears, and we at once recognise the unity of Nature's design, whatever be the means she resorts to, to accomplish it; namely, the production of plastic fibrine or lymph, into which, by uninterrupted elaboration, the vital elements, nerves, and blood-vessels, are ultimately interwoven. Hunter himself had all but furnished this explanation, in speaking of blood effused in wounds. "In many cases," says he, "in which we mean to produce union by first intention, it is not necessary to be very nice in spunging out the blood with a view to make the two surfaces of the flesh come entirely into contact, the blood itself answering a similar purpose. In several cases, having brought the two portions of loose skin together, I have seen the two cut edges unite almost immediately; and though the cavity underneath was distended with blood, yet it did well, the tumour gradually decreasing as the blood was absorbed; this is to be considered in the same light as an ecchymosis." When we read this passage, we cannot help wondering how a difference of opinion could have arisen on this point; and our surprise will be still greater when we read another passage, which occurs in the next page. "The mouths of vessels are soon shut, either by inosculation, or their own power of contraction, and by the blood becoming vascular, as in the former stated case of union by first intention; and if there be any superfluous extravasated blood, we know that it will be afterwards absorbed."

"The blood being alive, this uniting medium becomes immediately a part of ourselves, and the parts not being offended by it, no irritation is produced. The red particles are absorbed, and nothing but the coagulating lymph is retained, which being the true living bond of union, afterwards becomes vascular, nervous," &c. Here we see Hunter himself laying the foundation of the doctrine as to the unity of the end which Nature has in view, and even the unity of the means, although in the modes she resorts to to arrive at it, one may be more circuitous, more subject to interruption than the other. Possibly, the difference of opinion might have arisen from the circumstance that effused blood, particularly when the quantity is considerable, gives rise to great distension and irritation, or, when extravasated into a large uninflamed cavity, suppurates; but it should have been remembered, that, under such circumstances, the blood may lose its vitality, and thus become a foreign body; as long as extravasated blood is still alive, it retains the power of being vascularized anew, and of living in its new situation.

Another proposition of Hunter's, affirming that inflammation was necessary to produce adhesive lymph, has given rise to a controversy in which physiologists are still at issue. This point of doctrine, which, during a period of forty years, obtained universal assent, and which had been considered as established on an unshakable basis, has attracted the attention of modern pathologists, sharing thus in the scrutiny and experiment to which, in our own times, almost every important doctrine of medical science has been subjected. Perhaps it will prove, that the idea of inflammation, in too absolute a sense, has been attached to the term *adhesive inflammation*, and that Hunter had himself, in various passages, qualified the term in such a manner, as nearly to meet all the objections of the moderns. It should be recollected, how much more accordant it was with the great sagacity of Hunter, to study the phases and phenomena of inflammation in the various tissues, to mark and delineate them with the hand of a master, than to be critically exact in the terms he created to designate them. No one better than he had observed the circumstances which seemed to negative the existence of inflammation as necessary to the production of adhesion, circumstances which mark a mode of vitality which is now characterized as *irritation*, or *exaltation of organic action*. But he did not on that account perceive that there was anything forced in his grand generalization, when he included in it this state or mode of vitality, under the term *adhesive inflammation*.

When a wound is inflicted, lymph is effused, in the opinion of John Bell, from the divided surfaces, without any peculiar elaboration; the red blood ceases to flow, but a colourless fluid exudes from the divided vessels and from the *halitus* of the cellular tissue, which fills up the void, and equalizes the surfaces of the wound. John Bell thinks that the term *adhesive inflammation* is inapplicable to this process, which he regards as purely physiological. (*Discourses on Wounds*, p. 23.) The fact, that wounds adhere without the manifestation of inflammatory symptoms, strictly so called, was observed by Galen:—"Frequenter enim vidimus cùm integrum crus, brachiumve abscissum esset, coaluisse tamen vulnus, antequam inflammatio aboriretur." (*Adversus Erasistrateos*, Caput VII. Galenus.) M. Maunoir of Geneva, and Delpech, consider the adhesion that thus takes place, as a proof that the plastic lymph is not a product of any unusual action in the part, but the mere result of the coagulation and gradual hardening of the extravasated fluids. (*Mémoires sur les Amputations.*) M. Serre adopts the same view, and regards the phenomenon as appertaining to the same order, with that by which the ovum becomes united to the uterus. The opinion of the Physiological School of Pathologists is thus expounded by Roche and Sanson, (*Nouveaux Elémens de Physiologie*, ii. p. 504.) "Like the flow of blood, this exudation of the white fluids is owing to the division of the vessels of the tissues, and of the tissues themselves; when the opposing surfaces are placed in contact, this lymph is necessarily spread in a layer between the lips of the wound. Driven out from its natural conduits, and placed beyond the domain of vitality, it speedily coagulates. But the part is presently attacked by *irritation*, or rather already painful and irritated by the effect of the accident, its irritation increases rapidly, its vitality is augmented, and the layer of coagulated lymph promptly assumes the character of a membrane.

But we may ask, did Hunter deny that parts might adhere without any sign of inflammatory action being manifested during the process? Quite the contrary. In his division of inflammation into adhesive and suppurative, he seems less anxious about entering into a disquisition as to the constant presence of inflammation for the production of adhesion, than to mark the phases of the vital act that produces it. The idea which he connects with this act is that of increased activity of the nervous and capillary systems, with augmentation of the plasticity, which he is a witness will often arise without pain, redness, heat, or swelling. The sense which he attaches to the term *adhesive inflammation* is that of an action by which the vessels become capable of secreting the plastic element, and in this Thomson, Cruveilhier, and almost all the pathologists of this country, coincide. Thomson thus expresses himself in his admirable work on inflammation: "If the effusion of coagulated lymph ever does take place from the vessels actually divided, it would seem to depend on a change in the action of these vessels, by which they are in some measure converted from circulating into secreting organs." In speaking of the source of the coagulating lymph, Hunter says it is not easy to determine whether it comes from the cut vessels or the open cells; and in several passages in the same chapter he alludes to the painlessness of the action itself by which the lymph is produced. Thus, at page 319[1], he says, "It does not seem necessary that both surfaces which are to be united, should be in a state of inflammation for the purpose of effecting a union; it appears only necessary that one should be in such a state, which is to furnish the materials, viz., to throw out the coagulating lymph, and the opposite uninflamed surface accepts simply of the union; for I just observed, that extravasated blood produces a union without inflammation, and we often find adhesions of parts which can hardly be called inflamed."

One of the commonest alterations in the whole range of pathology is presented to us in those adhesions which occur between two portions of the pleural surfaces, and yet their production is effected in numerous instances without any perceptible symptom indicative of their formation. When it is remembered that there are some shades of inflammation, the phenomena of which are so slow and so obscure as to excite no suspicion of their existence, it will scarcely be denied that those adhesions in the internal membranes are produced without perceptible vascular excitement. We have just seen that this imperceptibility of the signs of inflammation is quite in accordance with the doctrine of Hunter; the excitation in the case of a wound may be equally imperceptible, though really present, the traumatic lesion producing no other effect upon the divided parts than that of placing them in the same condition as to the exudation of lymph that the vascular excitement had placed the internal membranes, and thus the cellular tissue may at once enter upon the reparative process, without manifesting the excitement.

As regards the opinion of M. Serre, we will not deny the analogy that exists between the process of adhesive inflammation, and that by which the ovum and the uterus become connected; nor is it necessary, in support of Hunter's views, that we should. Before we consented to debate the point, we should require of those who have taken up an idea on this subject, which they conceive to differ from that of Hunter, first, to prove that the process by which the parts of the fœtus become united differs from that by which it is effected in the state of extra-uterine existence. That which is inflammation in the fully-developed tissues of an independent organism may possibly present very different appearances in the fœtus, although the mode or act itself by which it is effected may be essentially the same in both cases. As we have already observed, the elements of the fœtus consist almost solely of the plastic kind, and are naturally in that state of active excitement which we conceive to follow the infliction of a wound. We may here repeat an observation which, amongst physiologists, obtains the currency of an axiom, viz., that which would constitute fever in the adult is normal action in the infant or the fœtus.

The act whereby adhesion is effected, whether by the adhesive or suppurative process, must be, both in its essence and elements, the same. In the first instance, coagulable lymph thrown out from the broken surface becomes the bond of union; in the second, the same lymph is thrown out by the granulations, and effects the same end. Nature has only been interrupted by the suppurative act, arising from the more active inflammatory process. Lymph is a living secretion, elaborated in a perfect state of preparation to form adhesions, so long as the excitement or inflammatory action, in virtue of which it is produced, remains confined to purely reparative limits; when the inflammation runs higher, the secretion is not reparatory, but morbid, and pus is formed. The secretion of lymph, whether from the cells, the ends of divided vessels, or the result of organic exaltation in the internal surfaces,—whether adhesions be morbid or reparative, the result is uniform; it becomes of the same nature as cellular tissue, from which, after a lapse of time, it can no longer be distinguished: it is, in fact, cellular tissue. This, to use the expression of Cruveilhier, is the organizing, as well as the disorganizing, element. No reparative process can take place in the muscular, tendinous, osseous, or nervous fibres of themselves; and if they were not abundantly supplied with cellular tissue, both within and around them, their lesions would be irreparable. Muscle contracts, nerve feels, and glands secrete; but to these purposes their functions are absolutely limited: their diseases are confined to their cellular tissue, and through it alone they receive the principles of nutrition or decay; and this is so strictly the property of the cellular element, and so active is this power where it abounds, that we often find, in treating surgical diseases, where it is desirable to prevent adhesion, how very difficult it is to control this tendency. Every surgeon knows what care and attention are necessary when it becomes an object to maintain a fistulous opening as a substitute for an obliterated natural one; as, for instance, the urethra obliterated by strictures and extensive extravasations, Steno's duct, the nasal duct, &c.

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[1] A Treatise on the Blood, Inflammation, and Gunshot wounds. Sherwood, Gilbert, and Piper; London.

Let us now trace the changes which take place in the effused fluid until it becomes fully organized. It is certainly a most remarkable property in blood, that the moment it comes in contact with an inflamed tissue it coagulates; this is one of the earliest effects of inflammation in an artery or vein: the inflammation of cellular tissue produces the same effect on the effused lymph, a fact which did not escape the observation of John Hunter, and which, by the way, might not have been destitute of weight with him when he connected adhesion with a *particular stage* of inflammation. After it has been effused twenty-four hours the coagulated lymph is white, areolar, and membraniform; in forty-eight hours, often earlier, it is vascularized, and furnishes blood from numerous points if any attempt be made to break it up; in three days its organization, though not perfect, is still more advanced; and in eight or ten, it is so solid that it resists any attempt at laceration as powerfully as the surrounding parts; finally, it is fibrous and cellular.

We have been hitherto contemplating the subject of adhesion, as between the two surfaces of an external wound. Let us now suppose a lesion in which the surface of the body covering the wounded parts remains entire, and there is consequently no access afforded to the external air, and no opening through which the injured parts can be relieved of the presence of the extravasated blood.

The question has been much agitated amongst pathologists, as to the mode by which the effused fluid establishes the continuity of the separated parts—Do the two ends of a divided vessel in a clean wound inosculate directly, when brought into contact or close proximity? Or do new vessels arise in the concrete mass of lymph, and by extending branches towards the surrounding parts, establish a new order of anastomoses?

In reference to the first question, Hunter observes, in a note, "I never could get an opportunity of observing it, in all my experiments and observations on inflammation, except in the coats of the eye. In many inflammations of that organ, we find an artery, or arteries, passing from the tunica conjunctiva to the cornea, and ramifying on that part. These have been cut across to prevent the influx of blood; the two ends are seen to shrink, but, in a little time, they are again perceived to unite, and the circulation is carried on as before. In this there can be no deception."

There is another experiment by Duhamel, which bears upon the same point. He broke the legs of six chickens: after the bones had united, he cut across about a third of the soft parts covering the callus; as soon as the wound had cicatrized, he cut across another third down to the bone; and when the second division had cicatrized also, he cut the remaining third. When the whole was healed, the injection from the upper part of the thigh penetrated to the extremity of the claws. "I cannot," says Duhamel, "affirm, whether the large vessels injected were dilated capillaries, or the large vessel of the leg itself reestablished, but this experiment proves irrefragably the inosculation of blood vessels." In this conclusion Duhamel however deceives himself; the experiment merely proves the possibility of re-establishing the circulation after all the large vessels surrounding the limb had been successively divided, but not the direct inosculation of the divided vessels themselves.

In regard to the second question, whether the new vessels are the product of spontaneous generation, the evidence seems more direct and conclusive. "In a vast number of instances," says Hunter, "I have observed that, in the substance of the extravasation, there were a great number of spots of red blood, so that it looked mottled. The same appearance was very observable on the surface of the separation, between the old substance and the new, a good deal like petechial spots. Was this blood extravasated along with the coagulating lymph? In this case I should rather have supposed it would have been more diffused. I have therefore suspected parts have the power of making vessels and red blood, independent of the circulation."

An ingenious explanation has been presented of the mode in which the new vessels are mechanically hollowed out, but which is not however offered to the exclusion of the vital influences which direct their formation. It is well known, from the experiments of Dr. Clanny and others, that the blood contains carbonic acid gas in considerable quantity. Brande estimates it at a cubic inch for every ounce of blood.

I saw Dr. Clanny procure it from the blood of a patient whom he had just ordered to be bled, by setting it under a receiver, which he exhausted. This gas is evolved from the blood while it is undergoing coagulation. If the coagulating mass be examined with a microscope, the gas is observed, by its bubbling, to escape in all directions, forming a net-work of capillaries, anastomosing with each other, and which remain visible when the coagulum is dried — the action resembling what takes place in the panary fermentation. It is obvious that the formation of these canals is owing to the escape of the gas, for when the blood is deprived of it by the air pump, before it begins to coagulate, they are not formed, and the mass remains soddened. It might be doubted whether the same phenomena would obtain in a clot shut up in the living tissues of the body; but the question has been set at rest by some experiments of Sir E. Home. In one of these experiments, a clot was formed by dividing a small branch of the mesenteric artery in a rabbit, which received the injection twenty-four hours after. He also succeeded in injecting a coagulum, just formed, from blood which he had abstracted from a vein. He describes the disposition of the newly formed vessels as branching out from the small ampullæ, or spots, (which first become elongated,) into a double arborescence, like that of the vena portæ. We shall see in another place that he makes the same remark in the case of the formation of granulations.

The process of vascularization has however been represented as taking place in a different manner by other physiologists. Gendrin thinks that the neighbouring vessels force blood into the coagulum, and thus the canals are prepared. Laennec states that the rudiments of blood-vessels are presented under the form of streaks of blood, which soon assume a cylindrical form, and ramify in the manner of blood-vessels. On the one hand, it is believed that the new vessels are fully formed before the blood is impelled into them from the surrounding capillaries; on the other, that they are developed by the action of the primitive vessels, blood being first driven through the coagulum, in the form of streaks, which streaks are hollowed into vessels by the continuance of the same action. The point on which both are agreed is, that the vessels themselves are continuous with the venous capillaries, and that they are susceptible of injection from the primitive vessels, whether arteries or veins.

When thus completely organized, it gradually undergoes changes, until it presents all the characters of cellular tissue, equally susceptible of deposit and alteration as the same element in any other part of the body. The complete similarity, however, has been denied; and it is maintained by some, that adipose matter is never deposited in the cells of the adventitious medium. In reply, it is only necessary to repeat, that the changes, by which the bond of union is rendered cellular, are exceedingly slow, and that the inflammation in which it originated has terminated, as it does so frequently, in induration, which even time will not always remove. Tuberculous, and other deposits, have been found in the new organic substance; and if fat has not, a point which is by no means certain, it would not prove against the general proposition expressed above. It is, however, believed by many, that fat may also be deposited when the new organization becomes perfectly cellular, which of course requires considerable time.

We have been hitherto considering the vascularization of lymph as a result of wounds. The living parts may also be the seat of the deposition of coagulating lymph, without the intervention of any external cause. Severe irritation arising, and continuing in a part for some time, the affected spot is isolated, by the establishment of adhesion in the surrounding parts; these being rendered impermeable by the deposition of a yellowish serum and coagulable lymph. This process is purely preservative, as the diffusion of the inflammation is thus completely checked. It is to the absence of this plastic barrier that the extensive ravages, that take place in phlegmonous erysipelas, are to be attributed. (See Abscess, Erysipelas.) When the inflammation does not proceed to suppuration, in other words, when resolution takes place, the deposited lymph is absorbed, and the cellular tissue is restored to its former condition, becoming permeable and areolar. When the inflammation has run high, however, the absorption is not altogether complete; the walls of the cells remain permanently adherent, in the same manner, and by the same bond, as that which unites the edges of a wound; the cells are thus effaced, and the parts are indurated. The effect of this change in the cellular tissue merits attention from the surgeon, as it often renders intricate and embarrassing the performance of certain operations, which, had no such change occurred, would have been easy and expeditious. Take, for instance, a tumour in the neck, which has involved the blood-vessels and nerves, and which has thickened the cellular tissue surrounding them; he can only succeed in removing it by slow and careful dissection, whereas, had the cellular tissue undergone no change, he could have rolled it out from its connexions with his fingers alone, as soon as he had divided the external integuments. We have been hitherto considering adhesion as a result of a certain degree of organic exaltation, so well named by Hunter, *adhesive inflammation*, and which, by uniting parts which otherwise must suppurate, serves as a barrier to suppurative inflammation.

We shall now offer a few observations on adhesion in surfaces that have suppurated, or, adhesion by granulation. This portion of the subject will be but briefly noticed here, as it will be described more fully under the head Cicatrix.

Granulations arise only in parts that have suppurated, and, wherever they occur, are seated or based on cellular tissue. Their name expresses their appearance tolerably well, being small, red, shining, and globular prominences, more or less elevated, and highly vascularized. As these corpuscules bring about the same event, namely, adhesion, are they of the same nature as the vessels or cells from which the coagulating lymph is secreted, which becomes the bond of union in wounds that adhere by first intention? Is their action in producing the means of union the same? Most probably. Hunter considered suppuration to result from inflammation, carried beyond adhesive limits; but suppuration ceases by restoring the parts within those limits, placing them in the same condition, in fact, as that in which the surfaces, or rather the granulations secrete the same plastic lymph. In order to produce suppuration artificially, it is only necessary to prevent adhesion. (See Reunion.) When there is no cause to perpetuate the production of pus, the granulations become covered with a layer of organizable lymph. It may be here remarked, that as blood coagulates upon inflamed surfaces, so does pus, according to the observations of Home, upon the surface of granulations. It would appear, therefore, that whatever adhesive power is found, either in pus or in blood, depends upon its vitality, for healthy pus is not dead matter in the midst of our tissues, but a living secretion. Home's observations on these granulations are exceedingly curious, and will be reproduced under the article Granulation.

When granulating surfaces are apposed, they become covered with a very thin pellicle, which prevents any further secretion of pus. As regards the production of the vessels by which the granulations are so richly supplied, the same difference of opinion prevails, some believing that they are formed spontaneously in the plastic lymph; others, that they are merely prolongations from the primitive vessels. Hunter believed that they might be produced in both ways. But, on this point, we might invoke Hunter's own authority against himself, in support of the opinion that these vessels are of secondary formation. Hunter observed, that the vessels of granulations took a direction from their base to the circumference in *parallel* lines; now the very same arrangement is observable in the vessels of false membranes, the spontaneous formation of which is not disputed. The same difference of opinion is here reproduced as to the inosculation of the new with the old vessels; and, although it is not possible to deny the communication of these vessels, still it is by no means an easy matter to prove the direct inosculation. We cannot determine whether the extremities of the old vessels merely throw out plastic lymph only, or whether the excitement, which no one doubts must exist in them, is still kept up to form, or to inosculate with, the new vessels; all we know, positively, is the fact that they do communicate, and are continuous with each other.

The preceding observations establish that organizable lymph is the sole medium of adhesion, that it is thrown out in consequence of a particular mode of excitement, to which Hunter gave the name of adhesive inflammation; and that this inflammation is necessary to modify the parts in order to produce its effusion.

Adhesions in different situations:—In a practical point of view adhesions may be arranged under two general heads, viz. morbid and reparative. Another division may also be made in which they are classed in reference to the structures or situations in which they occur. This division embraces adhesions, not only of the serous or mucous surfaces generally, as of the pleuræ, peritoneum, &c., but of the vessels, skin, mucous passages, &c. wherever they may be formed. We shall study them in the order of their frequency.

Adhesions of serous membranes:—The cellular tissue itself may be considered as constituted of a multitude of serous cells, but as we have spoken so much upon it, in developing the general principles of adhesion, we shall pass at once to the consideration of adhesions as they occur in the large serous cavities.

The first point we have to remark, as regards serous membranes, is the prodigality with which they furnish the lymph, which is afterwards converted into membraniform adhesions. The abundance with which the lymph is thrown out in the irritation of serous membranes, and the apparent absence of vascularity, had, doubtless, suggested the idea that the productions were inorganic; but this condition is merely temporary, and, besides the apparent absence of vessels, is no argument against the fact of their being organized. This readiness to throw out lymph is, in many instances, attended with effects that are eminently preservative. A collection of matter takes place under the pleura costalis; the contiguous pulmonic pleura adheres to it; the ulcerative process attacks the adhesion, and the pus is coughed up through the bronchi; or a fatal extravasation is threatened from some of the organs of the abdominal cavity, the adhesive matter is thrown out, the suffering organ becomes united to the nearest turn of intestine, and the matter, which was on the point of making irruption into the abdominal cavity, is safely carried out of the body, through the passage that has been provided for it by the intestinal canal. It becomes also, as in the case of an abscess in the cellular tissue, the means of circumscribing the effects of an injury. "If we make a wound," says Hunter, "in the cavity of the belly and do not allow it to heal by first intention, still we find that no inflammation will take place, or extend further, than the attachment of those parts to the cut edges, except what is owing to continued sympathy. If this was not the case, every part of the same cavity must inflame . . . . if this contact be destroyed the whole cavity must inflame, because every part is under the same predicament with regard to exposure. The same thing would take place in the common cellular membrane, if those cells were not (in a natural state) in contact. Inflammation, in case of wounds, would as readily extend over the surface of each cell as air does through the cavity of each cell when blown into. Now this simple and natural contact of parts keeps the inflammation from spreading beyond the cut edges of exposure, and the inflammation only takes place at this part to preserve this contact. . . The cause of the limitation of the inflammation is the simple contact; this contact renders the sides of the cavity perfect again, and sets bounds to the immediate cause." Hunter, Op. cit. pp. 310, 311.

There is therefore a remarkable tendency in serous membranes, as shown in numberless instances, to limit inflammation, or to circumscribe its effects. This, Hunter regards as a purely defensive effort of the constitution.

Upon the first occurrence of irritation in serous surfaces, the lymph, by which the contiguous parts are joined, exudes from them in the same manner as it exudes from the lips of a wound. Cruveilhier has observed that the lymph is firmest at the circumference of the exudation, being spongy and porous towards the centre; and hence he infers that the blood, pus, or membranous flakes, like the globules of pus, which we sometimes find in the midst of a coagulum, are not secreted in that situation, but percolated by capillarization through these porous membranes from the serous surfaces. It was long thought that these productions were not organic, but merely served the purpose of a medium through which the vessels were carried from one side of the inflamed membrane to the other; but this notion is now justly abandoned. The provisional state of the exudation, upon which this idea was founded, is now known to be transitory; it gives place to a fully organized state of this new substance, induced by means exactly similar to those which are observed in the developement of the placenta, a state in which it is supplied with vessels capable of being injected. The same observation as to the distribution and character of these vessels, which Home made respecting granulations, may be repeated here; a trunk sends off an arborescence of capillaries from both ends towards the circumference of the adventitious membrane, a miniature representation of the portal circulation; these vessels are exclusively venous. "I never," said Cruveilhier, "found arterial vessels in organized false membranes. They could serve no purpose, since their capillary venous system communicates with the generally capillary venous system, and, consequently, with the torrent of the circulation; and this fact is in accordance with experiments which have convinced me that the venous system is the immediate seat of secretion, inflammation, and nutrition."

These adhesions are produced in great variety, depending chiefly upon the degree of mobility of the parts in which they are developed. Sometimes the union is so close and intimate that there seems to be scarcely any interposed layer; at others, the bands are prolonged and broken into cells, or numerous slips. Several observations prove that they sometimes disappear in consequence of being ruptured in this process of elongation. It is by this process that the cure of artificial anus is effected; for if the parallelism of the two ends of the intestine, adhering to the abdominal wall, where the preternatural opening exists, were to continue, the re-establishment of the course of the fæcal matter through the lower portion of the intestine could not take place; it is by the elongation of the adhesion from every point of its attachment, that the curve of the intestine may be restored, and that the opening in the side of the intestine is gradually lessened till it closes completely. In one of Dupuytren's cases of artificial anus, through which the fæcal matter was discharged only for twelve days, an opportunity occurred for examining the parts, the woman dying seven months after. The portion of the intestine in which the accidental opening had existed, and which it was expected would have been found adherent to the cicatrix, was four inches from it. A long band of membrane, broad at both ends, and almost as small as a thread in the centre, connected the parietal cicatrix with the intestine; this band did not communicate with the cavity of the intestine. M. Ribes states that he had not been able to find the slightest trace of adhesion in his examinations of the bodies of soldiers, who had, at periods remote from the time of their death, received wounds in the abdomen; the traction which the point of adhesion must have been constantly exposed to, from the peristaltic motion of the intestines, will perhaps account for this circumstance. Having premised these observations on the adhesions of serous membranes in general, we shall now study them as they occur in each serous cavity in particular.

Adhesions in the pleuræ:—These are the most frequent of all, and are found in the bodies of half the adults that are opened. They are often produced without any symptom of pain. They result however almost certainly from inflammation of the pleura. When they are so extensive as to impede the full expansion of the lungs, the latter diminish in size, and the walls of the thorax fall in gradually in proportion to the diminution. When a lung shrinks under the pressure of fluid effused into the cavity of the pleura, if an adhesion already exists, the adhesion is elongated, and may thus stretch across the cavity. When suppurative action has occurred on a point of the serous membrane, the pus is isolated by the production of organized lymph, and may thus be eliminated through the bronchi, or through the intercostal spaces, a track being formed for it towards the surface. Collections of pus confined to a spot of serous membrane, and thus voided, are often met with in authors. It has been doubted in such cases whether the inflammation first arose in serous membrane; but whether so or not, it is well ascertained that such adhesions between contiguous portions of a serous membrane may arise when the inflammation takes place in the cellular tissue, external to the membrane. The possibility of the existence of adhesions should be borne in mind when it is necessary to have recourse to surgical means for the discharge of collections of fluid in the cavity of the thorax. It will not be always easy to determine the best point for the performance of the paracentesis; and it will therefore be best to proceed in all cases as if such adhesions really existed. (See Empyema.)

Adhesions of the peritoneum.—The extent of this membrane, and the number and importance of the organs with which it is connected, renders the study of its adhesions extremely interesting. (See Abdomen.) In some instances, where peritonitis has been general, it terminates (and such a termination may be regarded as favourable,) in the fusion into one mass of the omentum, intestines, &c. An inevitable result of this glueing together of the intestines, is the all but suppression of the peristaltic motion, or at least such a degree of it as would insure the due performance of the functions of these viscera. Life, it is true, may be continued under these unfavourable circumstances, but it is embittered by constant suffering. The embarrassment of function, through the loss of mobility, is aggravated too often by low enteritis, or irritation of the mucous membranes of the intestines, which wastes and often destroys the patient.

Partial adhesions of the peritoneum.—Adhesions of the peritoneum present innumerable varieties in form as well as in organization; they occur as filaments, bands, looking like ligaments, elevations, &c.; they are laminated, cellulous, fibrous, granular, or infiltrated, or studded with tuberculous deposits. The author of this article has, within a very few days, met with an instance of this kind. But even though not general or extensive these adhesions may be productive of considerable distress, according to the nature of the viscus, whose function they impede; even rings may be formed, in which fatal strangulation of a portion of intestine may occur. The mind of the reader will readily supply instances: the loose omentum may contract attachments from one point to another, into which a portion of a neighbouring intestine may be forced; the impregnated uterus may contract adhesions while high in the abdomen which may impede the progress of parturition, or prevent the return of the organ upon itself when the fœtus and placenta have been expelled, and thus expose the woman to the perils of hæmorrhage. The existence of adhesions that impede function is often revealed by a sense of weight, or traction, which is experienced at a particular part, or at a particular time, which is often that at which the impeded viscus is more especially engaged in performing its function, whatever it may be.

A partial peritonitis may arise during the formation of an abscess in the liver, inducing adhesion between it and the diaphragm, and the peritoneum lining the right hypochondrium; the effect as regards the adhesions being the same, whether the pus is formed in a cyst, or whether it is collected in the substance of the liver itself. These adhesions are purely preservative, as through them the matter may be safely conducted out of the system by an opening in the parietes of the abdomen, or by working its way upwards through the diaphragm and the lungs, until it finds an outlet in the bronchi. The same aptitude for adhesion brings the liver into union with the other organs that surround it, the stomach, the duodenum, the gall-bladder, &c.; and through these an outlet may also be obtained for the matter which is voided by vomiting, or by stool. The gall-bladder, too, may, in like manner, be joined by adhesion to the anterior wall of the abdomen; and this is a point of much surgical interest, as, through means of the adhesive bond, the gall-bladder becomes safely accessible. But we must observe that the signs indicative of this adhesion are not always such as to give the surgeon full assurance of their existence; and without such conviction he will not undertake an operation on the gall-bladder, which, if the adhesion does not exist, must be followed by fatal extravasation of its contents into the general abdominal cavity. Petit, in the Memoirs of the Academy of Surgery, has endeavoured to describe the signs which he considers indicative of their existence. He says, "If the patient lies on his left side, with his legs drawn up to his belly, and in this situation we strive to push the tumour from one side to the other, and we find it cannot be removed from the spot where it rises, it is a sign that it is adherent; whereas, on the contrary, it is a certain sign that it is not adherent if it follows the motion of the fingers, and can be moved from side to side: if there be œdema, or redness of the external part of the tumour, we may be certain that it is adherent." This œdema, or doughy condition of the cellular tissue, preceding the march of an abscess towards the surface, has been already noticed in that article. (See Abscess.) It is a part of the adhesive process as it is developed in the intermuscular or sub-cutaneous cellular tissue, and it exhibits the difference between the extravasation of concrescible lymph and thin serum. An abscess is bounded by its proper cyst, which is coagulated lymph; beyond this boundary is the thin serum, which infiltrates the cellular tissue in advance of the purulent cyst, giving it the œdematous appearance and doughy feel. But even should these signs be present it will be better for the surgeon to establish the opening by means of caustic; for if the adhesions should not be fully formed they will be promoted by the irritation of the caustic, as adhesions of the peritoneum are produced, by external as well by internal irritations. In these cases it will perhaps be useful to bear in mind the feeling of rubbing, which Dr. Bright has found, in cases of adhesions between the visceral and parietal portions of the peritoneum, and in watching the progress of a case to ascertain whether it presents itself. The gall-bladder may also adhere and communicate with the colon.

In the left hypochondrium the spleen, under the influence of irritation, may contract adhesions with vicinal organs; it is thus found united to the stomach, the diaphragm, &c., and collections of pus may find their way from it into the thorax, stomach, colon, the kidney, or through the parietes of the abdomen.

The stomach is not exempt from the liability to contract adhesions; and under certain circumstances they may prolong or preserve life. In cancerous affections the perforation of the stomach would often occur much earlier than it does, if it were not prevented by the adhesions which unite the walls of the stomach to those of the surrounding organs. The fistulous openings, by which the stomach is connected with the external abdominal wall, and through which physiologists have been enabled to conduct some very interesting experiments on digestion, are established by means of adhesion, uniting the wounded organ to the wall of the abdomen.

Adhesions occur also between different portions of the small intestines, and are sometimes the effect of disease originating in the internal or mucous surface of the intestine. When this disease has proceeded to ulceration the peritoneum covering the ulcerated intestine adheres to the intestine apposed to it, and an opening is thus made between the two portions, which renders the intermediate turns of intestine useless. In cases of stricture proceeding to obliteration of the alimentary canal, nature attempts to re-establish the continuity by setting up this wonderful process of conservation. It was found, on examining the body of Talma, the celebrated tragedian, who died of obliteration of a part of the intestinal canal, that this process was nearly completed. In such cases, however, the communication is not always established between the upper and lower portions of intestines; it sometimes takes place between the intestine and the bladder.

The uterus and its appendages, in the diseases to which they are liable, may be glued together, or the uterus alone, in the malpositions of that organ, to the neighbouring organs, the rectum, and bladder. In cancer of the womb the adhesions preceding the alterations of the organ may effectually protect the peritoneum from any effusion of the morbid fluids, until it is in great part destroyed; or these organic alterations may produce such a degree of pressure on the organs in the neighbourhood of the uterus, as to produce a suppression of their functions. A case of this kind came very recently under my own observation. I was called at the request of the board to consult with my friend Mr. Bainbridge on the case of a patient in St. Martin's workhouse, who had not made water for five days. On examining the body after death, the cause of the obstruction to the flow of urine was found to be a carcinomatous enlargement of the uterus and its appendages, producing by pressure a perfect occlusion of the ureters, which were very much distended with this fluid. The autopsy was performed by Professor Partridge, of King's College. The preparation is in the Museum. The same disposition to adhesion is observable in the ovaries and uterine tubes; and M. Renauldin remarks that they are frequently found in women who lead a life of prostitution.

The purulent cyst of an abscess of the mesentery may extend towards the small intestine at its edge, and make way into its cavity; in the case of tuberculous deposits in the adventitious membranes, already mentioned, this communication between the mesentery and the intestine had been established.

Adhesions of the peritoneum in consequence of wounds.—These adhesions take place with remarkable celerity. (See Abdomen, Wounds.)

Instances are exhibited in the establishment of an artificial anus from strangulated hernia, where the surgeon is compelled, for his patient's safety, to leave the intestine unreturned; the adhesions by which it is secured in the lips of the wound are established in a few hours. It is upon this beneficent disposition in the serous membrane to contract adhesion rapidly, that M. Jobert's treatment of wounds, dividing the entire intestine, is established. This surgeon turned the cut edges of the lower intestine into the hollow of the gut itself by a sort of intus-susception, and then introducing the upper portion the two serous surfaces were made to correspond. Many experiments have been made with a view to the union of wounds of the intestines, all more or less directly founded on this property in the peritoneum. On this interesting point of surgical practice the labours of Mr. Travers deserve honourable mention[1]. M. Cruveilhier mentions a case of invagination of a foot of the intestine, in which the adhesions between the serous surfaces were so strong that the invaginated portion could not be drawn out.

Adhesions of the peritoneum in consequence of hernia.—Adhesions and transformations of tissue occur in endless variety, and often very rapidly too, in the contents of a hernial sac, and between these and the sac itself; and it is on such adhesions, much more than on want of space in the abdomen for their reception, in protrusions of long standing, that their irreductibility depends. In such cases the impossibility of cure arises from the adhesions: in newly-formed protrusions, on the contrary, when the intestines are fairly returned, all our hopes of obliterating the sac depends upon our success in inducing the adhesion of its sides.

While the surgeon is mindful of this power in the serous membrane to produce new matter, he will proceed with caution in his incisions to relieve an incarcerated intestine or portion of omentum. The deposition of the coagulable lymph may be so thick between the sac and the protruded intestine, that, on arriving upon it, he may mistake it for the omentum; or he may suppose that he has not yet arrived at the sac, and may wound the intestine. The principal circumstances connected with these adhesions, together with the indications they suggest, will be considered in the article HERNIA, to which the reader is referred.

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[1] Travers, on Wounds of Intestines.

The adhesions of the pericardium are next in the order of frequency: their production is regulated by the same vital powers as in other membranes of the same class, but they are formed under the influence, and of course modified by the unceasing motion of the heart. They demand no particular notice in a surgical point of view. This last observation applies also to the adhesions of the arachnoid. They are not frequent.

Adhesions of the tunica vaginalis.—The production of adhesion in the sides of the tunica vaginalis, by inducing inflammation as a cure for hydrocele, is a good instance of the curative effects of adhesion. This excitement of the walls of the serous cavity may be induced in various ways,—by inflammation of the testicle itself, by blows, a blister, the shock of an emetic, &c., or after the evacuation of the serum accumulated in hydrocele, by the injection of irritating fluids, &c. The tunica vaginalis, originally a prolongation from the peritoneum prepared for the descent of the testicle, is only cut off from that cavity by the process of adhesion. The communication is in general obliterated as soon as the testicle descends; if it should persist after this period, some portion of intestine descends also, forming what is called a congenital hernia.

Adhesions of synovial membranes.—Injuries in the neighbourhood of joints, sprains, fractures, aneurisms, dislocations with much contusion, greatly tend to inflame the synovial membrane, and adhesions followed by an anchylosed joint sometimes take place. The long continued immobility which is required to restore a fractured limb has produced the same effects.

According to Sir B. Brodie[1], the usual consequences of inflammation in the synovial membranes are, 1st, A preternatural secretion of synovia; 2d, An effusion of coagulable lymph into the cavity; 3d, A thickening of the synovial membrane, with cellular bands adhering to its reflected folds. This eminent surgeon believes that it is only violent and continued inflammation which terminates in the effusion of coagulable lymph in joints.

In proportion to the inflammation it has undergone, the synovial membrane has been found covered by a false membrane, or a soft kind of cellular tissue. Consequent to a fracture in an articulation, Dupuytren has seen the synovial membrane red, and presenting long membranous filaments of adhesion extending across the cavity of the articulation. M. Cruveilhier found the cartilages, synovial membrane, and capsule of the hip joint transformed into a dense cellular tissue of a very red colour.

The articular synovial membrane is rarely the seat of adhesions. "True anchylosis of moveable joints," says Cruveilhier, "does not so readily happen as has been supposed. I know of but three species of this disease. 1st, The articular surfaces are not implicated, but the joint is held immovable by an osseous ring, or by the less regular deposition of osseous matter around the joint. 2nd, The articular surfaces are absorbed, and the anchylosis is maintained by an interposed fibrous lamella. 3rd, The cartilages are absorbed, and the adhesion is effected by bony matter which is formed through the cartilages in a similar manner as occurs in the final junction of the epiphysis of long bones."

Adhesion of the synovial sheaths, on the other hand, is not of unfrequent occurrence. Inflammation but rarely occupies this neighbourhood, without their surfaces participating in it, and becoming cellular. The vesicular synovial membranes of the tendons are said to decrease in number in old age. Cellular transformation of sheaths is produced by old standing ulcers situated near them. The intense inflammation of panaris often agglutinates the tendons of the fingers to their sheaths.

The curious retraction of the fingers is caused by an altered condition of the sheaths and flexor tendons, strong and dense adhesions having glued them together.

Adhesions of serous cysts.—The treatment of accidental cysts, upon the plan employed to obliterate the tunica vaginalis, has been successfully adopted in many instances, and is preferable, when circumstances permit, to simple evacuation by puncture, to excision, or to the seton. Cysts of small size, and in situations where they are of easy access, are perhaps best treated in this way. Experience has even shown that cysts of the ovaries and of the liver may be obliterated by irritating injections. When cysts are of small size, evacuation with a needle and pressure will be often sufficient to produce adhesion.

Adhesions of the skin.—These can never occur, until the inorganic layer covering the integument is removed. But when the epiderm is removed as by burns or abrasion, adhesion readily takes place between different portions of the skin, provided they be kept in contact. (See CICATRIX, BURNS.)

Adhesions in blood-vessels.—In irritation of arteries and veins the same disposition to contract adhesion is observable. The same may be said of the veins; but they are obliterated more slowly than the arteries, and there is a marked difference in the mode in which inflammation affects these two orders of vessels. When an artery inflames, the blood in it coagulates, and becomes organized; in a vein adhesion may take place, to be subsequently destroyed by suppuration. Whatever causes compression on a vessel, and arrests the course of the circulation through it, may produce its obliteration. It may also be the result of disease, as in dry gangrene, or of operations performed on the vessels, as in blood-letting, the application of a ligature, *refoulement* (see TORSION of Arteries), wounds, &c. The value of torsion as a means of arresting hæmorrhage is entirely established on the production of adhesion in the coats of the twisted vessel, which takes place much more rapidly than when a ligature is applied. How strange it is, that English surgeons, who have been so long in the habit of healing by first intention, for which the process of torsion is so admirably suited, should be slow to adopt it; while the French surgeons, whose conversion to the doctrine of healing by first intention has been so tardy, have shown a readiness to abandon the ligature! The obliteration of a vessel converts it into a fibrous cord. (See LIGATURE, ANEURISM, ARTERY, PHLEBITIS.)

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[1] On Joints.

Adhesions have also been observed in the thoracic duct. M. Nasse, of Bonn, found the thoracic duct obliterated, from the second lumbar vertebra to the left subclavian vein, and converted into a cord as thick as a goose quill, though the valves were still distinguishable. Sir Astley Cooper has seen three cases in which this canal was partially closed; and Andral has seen one. The obliteration of the lymphatic vessels has not, perhaps, on account of their exiguity, been observed; but that such a change does take place has been inferred from analogy, as well as from the fact that they do inflame. M. Breschet, however, denies that any authentic observation has been made to establish a single case of the obliteration of a lymphatic vessel.

Adhesions of mucous surfaces.—Mucous membranes resemble, in their organization, that of the skin, with which they are continuous at the various natural apertures of the body. The skin is provided with an inorganic layer for its protection, called the epiderm; the mucous membranes have also a similar protection, derived from their *epithelium*, which is an epiderm of extreme tenuity spread over the secreting surfaces. When examined with a microscope the mucous membrane is, moreover, found covered with a soft villous plush, which prevents *perfect* and *intimate* contact between different portions of the same membrane.

On the subject of adhesion of mucous membranes there has been a great deal of discussion, some denying its possibility altogether, others maintaining that it did take place under certain circumstances. On this point, however, it is obvious that it was rather a misunderstanding than any real difference of opinion that prevailed. Bichat, who is said to have believed in the impossibility of adhesion in mucous membranes, was too good a physiologist, and too accurate an observer, to have entertained, in an unqualified sense, any such opinion.

There is unquestionably a most striking contrast in the adhesive disposition, and susceptibility, in the two classes of membranes, and this for purposes so obvious, that we cannot refuse to acknowledge in this salutary arrangement a result of wisdom and foresight. Any considerable adhesion between mucous surfaces would, in many instances, be destructive of life, as in obliteration of any point of the alimentary canal: while the omission, or the insusceptibility to contract adhesions in serous membranes, would often expose the individual to the unbounded ravages of inflammation and extravasations, and bereave the practice of surgery of half its well-won laurels. The proneness on the one hand, and the insusceptibility to contract adhesions on the other, may be thus exemplified. A collection of pus in one of the great cavities is carefully conducted towards the surface, where it is consigned to nature, or to the surgeon for its complete evacuation; while an aneurism enlarges in an internal situation also, condensing and applying to itself all the cellular tissue it meets in its progress, till it is stopped by a mucous membrane, which refuses to adhere as the other structures had done; and the sac bursts, and fatal hæmorrhage follows.

Like the skin there is but one impediment to the adhesion of mucous membranes, and that is the epithelium; remove it, and the adhesion, if there be contact, is easily produced. One remarkable effect of chronic inflammation in mucous canals is a gradual narrowing, even to complete obliteration in some cases; this is observed in the trachea, where tracheotomy has furnished an aperture for breathing; in strictures of the intestinal and urethral canals, when the fæces or urine obtain other means of exit, without which life could not be prolonged.

In acute inflammations of the mucous membranes, for instance of the pharynx or larynx, (*angina pellicularis*, or *diphtherite* of M. Bretonneau,) membraniform flakes or layers are thrown out, frequently in great profusion; they are exactly of the same nature as the plastic exudations from other tissues. They do not adhere to, or rather they are detached from, the mucous membrane, in consequence of the mucous membrane itself remaining entire, and therefore in a state incapable of contracting adhesion with the false membrane.

Are the narrowings that take place in the mucous passages a result of adhesion? Probably not. The gradual diminution of these passages may be explained without the intervention of the adhesion of the mucous surfaces themselves, at least till a very advanced period of the progress of coarctation. The submucous cellular tissue may become the seat of deposits; it may be thickened or hypertrophied, so as to encroach upon those passages, and narrow them to such an extent as to embarrass them seriously, and even render impossible the fulfilment of their functions. The vagina is subject to this sort of narrowing from acute or chronic inflammation, and I have myself lately met a case in which the almost complete obliteration of this canal was coincident with, and perhaps a consequence of long standing engorgement and alteration of the structure of the uterus. Dr. Mackintosh of Edinburgh possesses a large collection of preparations of the uterine organs, in many of which these coarctations are very remarkable in regard to the *os uteri* itself. Meckel, Walthers, and Breschet have observed in women of advanced age, as also in prostitutes, the mucous surfaces entirely obliterated by adhesion.

The urinary mucous passages are also the seat of narrowing and adhesion. I have, in a calculous patient, observed two strictures in a dilated ureter which had given passage to several calculi. The body of the bladder itself, and its mucous membrane, narrows under the influence of long continued irritation. There is nothing more common than the narrowing of the urethra, either by the alterations of its submucous cellular tissue, or by membranous productions (*brides*) from its proper surface. The glans and prepuce adhere firmly. I lately saw a case in which I was obliged to dissect the prepuce from the glans; the adhesions were very firm, and a band had nearly shut up the orifice of the urethra. The patient had been on a remote station, serving as an officer in an African regiment, when he contracted the inflammation which terminated in these adhesions.

The other mucous canals of the genito-urinary system have been also found obliterated. The gall-bladder and cystic duct, the pancreatic duct, lachrymal puncta, the Eustachian tube, Steno's duct, and those of the sublingual and submaxillary glands may be obliterated from acute, or chronic inflammation, long continued.

The removal of the inorganic epithelium, and the alteration of the natural secretion, must in all probability take place when the eyelids become adherent to each other and to the conjunctiva. In the cuticular excoriation, or *scalding*, as nurses term it, occurring in infants who are not properly attended to, the labia pudendi become adherent. High inflammation, with ulceration of the vagina, may be productive of the same result in this canal. Dupuytren states that his attention was requested to a woman who had suffered a rupture through the recto-vaginal partition in the course of a difficult parturition; and, upon examination sometime afterwards, he was astonished to find the vagina so much obliterated by adhesions, that copulation was entirely prevented. Cruveilhier mentions another case, in which complete adhesion of the entrance of the vagina was produced by the use of an injection of corrosive sublimate.

The tendency in mucous membranes to contract adhesions, we thus see, is extremely powerful. The frequency with which fistulous openings, and long sinuous tracks, are established, and the obstinacy they manifest against the means resorted to by the surgeon to procure their obliteration, is no argument to the contrary; their resistance to adhesive action is the same as that of the natural passages, and depends upon the same cause, namely, the integrity of the accidental mucous membrane.

Curative indications of adhesion.—Having considered adhesion in a general manner as a result of inflammation. we may now advert to it as a means of fulfilling some of the most important indications in surgery.

When John Hunter, in his experiments, transplanted the soft horny spur from a cock's leg to the comb, and produced adhesion between parts so naturally incongruous, he was only illustrating the vital powers, upon the action of which union by first intention depends. When he observed the exudation of lymph from the surfaces of the wound, and that this lymph, without which union is impossible, soon became penetrated by blood-vessels giving rise to that action which he called *adhesive inflammation*, he was but extending those principles, and developing, with the hand of a master, their great practical importance. In our times the importance of his labours is manifested in the numerous brilliant applications which modern surgery has made of this wonderful law of the animal economy, and which constitute exclusively all those operations for the supply of deficient parts, the restoration of mutilated features, and the correction of many deformities known under the general name of Autoplasty. Nature in wielding the power of adhesion is guided in general by the intent to prevent or limit mischief, or to eliminate, by a route which the normal condition of the organism had not provided, morbid products or secretions, the presence of which would cause destruction. Adhesion is thus often the only thing needed, the point which decides for life or death. The many important purposes it becomes subservient to in the hands of the surgeon entitles it to rank as a therapeutic agent of the first order; and, indeed, there is no page of British surgery to which we may refer with higher pride than that in which Hunter first developed the laws of adhesion, and none which has had a more direct influence upon the recent progress of the art.

When the cavity of an abscess is to be obliterated, the cure of a hydrocele to be effected, the circulation to be cut off from an aneurismal sac by a ligature, it is by adhesion that the surgeon accomplishes the desired object. When the cure of an aneurism is spontaneously effected, or the progress of gangrene arrested, it is to adhesion in the blood-vessels that the result is due. It is to adhesion, in fine, that we are indebted for the cure of artificial anus, the obliteration of fistules, and the restoration of the integrity of injured parts in whatever organ of the body the solution of continuity may occur.

A principle so important and vast as adhesion must find extensive applications in surgery, which the reader will find under various heads throughout this work, and for which he is referred more particularly to those of ABDOMEN, ABSCESS, BURNS, BONE, CICATRIX, CYST, HARE-LIP, HERNIA, HYDROCELE, REUNION, RHINOPLASTY, STAPHYLORAPHY, SUPPURATION, WOUNDS, &c. &c.

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ADHESIVE PLASTER; *emplastrum adhæsivum*, Lat.; ἔμπλαστρος, Gr.; *emplâtre agglutinatif*, Fr.; *Pflaster*, Ger.; a solid and tenacious compound, thinly spread on linen, paper, or leather, adhering to the skin at the ordinary temperature of the body. Plasters in general are composed of unctuous substances, united with wax, resins, powders, metallic oxides, &c., and are prepared by heat. Adhesive plaster is employed in surgery, to keep the edges of wounds, resulting from operations or injuries, in contact, until they become adherent; to make compression, with a view to accelerate cicatrization in old and indolent ulcers; to contain blisters, issues, sinapisms, dressings, &c.; to protect exposed surfaces from friction, stripping, &c.; to prevent the air from penetrating in wounds of the splanchnic cavities and articulations; and in the opening of certain abscesses, by successive puncture. (See Abscess.) The adhesive plasters in most common use are, the diachylon, the court plaster, and the plaster prepared by the dissolution of gum ammoniac in vinegar, spread on cloth. This last is often found useful, where the skin is moist, as it requires moisture to make it stick. The court plaster, which is made of a solution of isinglass, thinly spread on moderately fine muslin or silk, repeatedly rubbed with a little tincture of benzoin, requires also to be moistened a little when applied; but it soon dries, and curls up at the edges, and can only be employed on small surfaces.

When the adhesive plaster is made in large quantities a machine is used for the purpose; it consists of a table with two uprights, which are moveable, and furnished with points; between these a metallic plate is fixed, under which the cloth is drawn; the under edge of the plate spreads the melted plaster evenly, while the cloth is drawn in lengths.

Unbleached calico is best adapted for making good adhesive plaster, on account of its downy surface, affording firmer union with the glutinous substance. Calendered cloth is not adapted for the purpose, as the plaster cracks and drops off from the already glazed surface. The cloth should be very even in texture, neither too fine nor too coarse. The emplastic substance should be so compounded as to soften at a gentle heat; and with this view, regard should be had to the season in which it is to be used, whether winter or summer, and the ingredients modified accordingly.

For use, adhesive plaster is cut into bands or straps, of various lengths and breadths, in the length of the cloth. When used for closing flaps upon the stump, after amputation, some surgeons cut their straps not quite straight, but slantingly, so that the middle of the strap is somewhat narrower than either of the ends. This mode of cutting the slips has two advantages; the wider ends give firmer hold, while the narrow centre, corresponding to the line on which the flaps are united, covers the wound less, and allows spaces for the escape of sanguineous or sero-purulent fluid exuding from its lips, which, if retained, would give rise to pain, tension, inflammation, and the formation of an abscess.

The mode of applying the straps is very simple: the lips of the wound having been brought into contact, and adjusted, and so maintained, when necessary, by an assistant, the surgeon takes between the index finger and thumb of each hand, the ends of the adhesive strap, and after heating it a little before the fire, or by passing its outside surface, from end to end, over a moderately heated Italian iron, he applies one of the ends to the least moveable of the lips of the wound, and assists its agglutination by pressing it with his fingers; the assistant then holds it firmly to prevent its slipping off, while the surgeon, having both his hands now free, re-adjusts the lips of the wound, and applies the other end of the strap down the skin of the opposite flap. He then applies, in succession, as many slips as may be required. The manner of disposing of the straps varies according to the direction of the wound; when straight, they are applied perpendicularly to its direction; this rule should be adhered to in the application of every single strap, so that if the surgeon has to deal with a semicircular wound, the straps take the direction of radii from a common centre, crossing from the convex to the concave side of the wound. Some surgeons place the first strap over the middle of the wound, and in many cases it is the most convenient mode, but it is often a matter of indifference whether it be placed at the middle or the extremities; in large flaps, the middle strap should always be applied first; in such cases, the adhesive plaster will be often insufficient to hold the lips of the wound in contact, and a point of suture may be required for this purpose; or it may be necessary to support the adjacent parts by graduated compresses of various forms, skilfully applied and maintained. Ancient surgeons had an idea, that the adhesive plaster was applicable only for the reunion of wounds of the skin, and subjacent cellular tissue, and consequently employed sutures much more frequently than those of the present day; they called the union by adhesive bands, *the dry suture*, that by *stitches*, the bloody suture. (See Suture.) They also made use of a mode of bringing the lips of a wound together which may be regarded as uniting the principles of both; it was effected in the following manner:—two indented slips of adhesive plaster were pasted over the brinks of the wound, of a width sufficient to insure firm agglutination; the indented edges, corresponding with those of the wound, had threads sewed to them at short intervals; the edges being brought into contact, the threads were tied across the wound. They were also in the habit of fenestrating their emplastic applications, a practice which is still continued for light dressings over suppurating wounds, at the Hotel Dieu.

The parts over which the diachylon adhesive straps are to be placed should be shaved previously; if this precaution be neglected very annoying pain is felt, and sometimes separation of the agglutinated parts is produced, when it becomes necessary to renew or remove the slips; they should also be washed, and sponged quite dry, before the bands are applied; the latter precaution is unnecessary when the court plaster, or the gum ammoniac plaster, is employed.

The removal of the straps requires great gentleness; the surgeon should begin by detaching one end, until he has freed it, to within an inch or so of the edge of the solution of continuity; he then detaches the opposite end of the same slip, till he has approached the wound in the same manner, then, taking both ends together, he gently draws them off the face of the wound in a direction perpendicular to it. If it be completely cicatrized, the straps are all successively removed in this manner; but if the object be simply to remove them, in order to apply others, instead of those that have become soiled, or that have fallen out of their proper bearing, they should be removed and replaced one by one. The length of time they may be allowed to remain varies according to the firmness with which they adhere, the extent and condition of the wound, the lightness with which they lie, their inoffensiveness to the parts, &c.; they may remain on, in general, from one to eight days.

If the bands are placed unevenly, or in such a manner as to make folds of the skin, they may give rise to great pain, inflammation, suppuration, and even to the formation of a slough; it is not uncommon in delicate persons of fine skin, and in children, for the pressure of the adhesive straps to produce an eruption of small, painful, pustules; and when erysipelas prevails in hospitals, it often seizes on solutions of continuity, that are too tightly dressed. In the latter case, the straps should be slackened; and, in the former, cold lotions, light dressing, &c., will quickly dissipate the irritation. When their tightness gives rise to extensive inflammation, it may become necessary not only to relax them, but to remove them altogether, and apply a large emollient poultice.

The diachylon adhesive plaster is often observed to turn black in the part that covers the wound, which, in its turn, is blackened by it; this arises from the oxide of lead, one of the ingredients, combining with the sulphuretted hydrogen from the wound, and forming a black sulphuret of lead. (See Ulcers, Compression.)

(*Wm. B. Costello.*)

ADUSTION, *adustio*, Lat.; *adustion*, Fr.; the action of fire on the living tissues; synonymous with actual cautery. (See Cauterization.)

ÆDŒATOMY, *ædœatomia*, Lat.; (from αἰδοῖα, 'the pudendum,' and τέμνω, 'I cut,' Gr.) the excision of the labia pudendi, and of the clitoris, when hypertrophied.

ÆGYLOPS, or ANCHYLOPS, αἰγίλωψ, Gr. (from αἶξ, αἰγὸς, a goat, and ὤψ, the eye.) An ulcer in the internal angle of the eye, so named from its giving to the human eye some resemblance to that of a goat; this ulcer results from the bursting, externally, of a small abscess situated over the lachrymal sac. In some of the old writers it is described as the fistula lachrymalis, of which they regard it as the first stage or degree. But the ægylops may exist while the apparatus for the excretion of the tears still continues in a state of perfect integrity; it is not converted into the fistula lachrymalis until, by the progress of the ulceration, a communication is established through the posterior wall of the abscess with the lachrymal sac. The lachrymal sac is protected from the extension of the inflammation; and the simple ægylops is easily cured, by such treatment as will be proper to relieve the congested cellular tissue. But no time should be lost, as the bulk of the tumour, by arresting the flow of the tears through the proper channels, and producing epiphora, adds greatly to the irritation in which the affection originated. The surgeon should be careful not to confound ægylops with fistula lachrymalis, the treatment of the two affections being very different. In the first stage of the tumour, recourse must be had to local depletion, by leeches, the application of emollients, and the antiphlogistic regimen. Should the abscess form, it should be opened as soon as the smallest point of fluctuation can be discovered; should the surgeon not be consulted till the ulcer is established, he should ascertain that the lachrymal sac is still entire. When the case is so, the probe does not enter the sac; injections through the lachrymal *puncta* will not pass through the ægylops; besides the history of the case, the condition of the pus, &c., will help him in forming his diagnostic; the ulcer should then be dressed with dry lint, and gentle pressure should be made on the thin and detached edges; these, as well as the fungating granulations of its surface, should be touched with caustic, great care being taken to avoid injuring the lachrymal sac. By the methodical employment of these means, and attention to the general health, should it be necessary, the ulcer will be speedily cicatrized.

AGALACTATION, see Aglactation.

AGARIC, *agaricum*, Lat.; ἀγαρικὸν, Gr.; *Bläetterschwamm*, Ger.; *amadou*, Fr. Its name is derived from a region of Sarmatia. Agaric is a species of fungus, or champignon, growing on the oak, the linden-tree, &c, It is prepared by drying the fungus, beating it out with a heavy wooden mallet, cutting it into pieces, and beating it out again, until it becomes quite a soft and pliant felt: it is employed in surgery to arrest hæmorrhage from leech-bites, bleeding ulcers, and small vessels, from which the blood oozes after operations.

It was first introduced into use by Brossard, a surgeon of Chartres, about the middle of the last century, and was received with great enthusiasm as a substitute for the ligature, cautery, &c. It is needless to add, that no one, at the present day entertains any such opinion of the effects of the application of agaric. It is proved beyond a doubt, that it possesses no styptic or astringent property whatever, and that it only acts mechanically, or in the manner of a tampon, or plug. (See Hæmorrhage, Hæmostatics.) When applied to a bleeding surface, it rapidly absorbs the moisture of the wound, together with the serous parts of the blood; the blood is thus made to coagulate at the very mouths of the vessels which furnish it, while the coagulum itself derives solidity from the agaric, which becomes adherent to the surface on which it is applied. There are, however, some precautions necessary to insure this effect. The agaric should be perfectly dry, and the surface of the wound should be spunged dry, at the moment of its being applied; it should then be held firm, and with a degree of compression, to the bleeding surface: when this is neglected, the agaric becomes penetrated with the moisture, the bleeding goes on, and it is soon detached, with the clot itself. When the methodical application of the agaric fails, the bleeding vessels must be sought for and tied; or if the blood oozes from a large surface, recourse must be had to the application of ice, or to actual or potential cauterization.

AGGLUTINATION, (from *agglutinare*, Lat.; κόλλησις, Gr.;) the glueing together of parts that have been separated. It indicates the early stage of adhesion, during which plastic lymph is thrown out; the union in this state is mechanical, and may be dissolved by even a slight disturbance of the parts. But this lymph becomes organized, and the state of agglutination passes into one of firm adhesion, endowed with a power of resistance equal to that of the surrounding parts. (See Adhesion, Cicatrization, Adhesive Plaster.)

AGLACTATION, AGLAXIS, *agalactia*, Lat.; ἀγαλακτία, Gr. (from *α*, and *γάλα*, 'milk,') *Milchmangel*, Ger. Absence of milk after parturition, or its suppression by disease, or any cause independent of the will; and in this respect, it differs from ablactation, in the production of which, by the employment of certain means, the will concurs. The milk may be secreted and retained, as in *mastoitis*, vulgarly called the *weed*, but this is not the case we are now considering.

The secretion of milk does not take place after parturition; or, if begun, it ceases when any important organ is seriously attacked, and this the more certainly, if the organ should be closely connected, functionally, with the mammæ themselves: thus inflammation of the uterus and its appendages will be most likely to be accompanied by the suppression of the milk, although it takes place also, when the peritoneum, pleura, lungs, brain, cellular tissue, &c., are seriously involved, as in puerperal, or general fever. Nurses and attendants usually describe it, in popular language, by saying that the *milk has flown to the head*, *&c.*, an idea which, in the present state of pathology, it is scarcely necessary to observe is altogether erroneous. The secretion is simply suppressed; but the milk is not translated to the inflamed organs. The mammæ become flaccid, and there is, doubtless, resorption of some portion of the milk; but it is eliminated, as resorbed fluids are, and does not hurtfully, and in its integral condition, circulate with the blood, The suppression of the milk constitutes an unfavourable complication of the malady, as the suppression of the cutaneous perspiration, or of the urine may in other circumstances; in either case, however, it is the effect, and not the cause, of the malady.

Upon the subsidence of the general excitement, the secretion is restored spontaneously, particularly when the disease, during which it disappeared, has been of short duration. But when the disease has existed for some time, there is often no return of the secretion, after the disease has been completely subdued.

The suppression of the mammary secretion sometimes takes place without any appreciable cause; this is observed mostly in young and over-anxious mothers of spare habit, and in whom the mammary glands are but slightly developed, persons residing in close towns, and in ill-ventilated situations. It also occurs in consequence of mental emotions in the nurse. Some women cannot suckle their children in the presence of a stranger, being for the moment as powerless in this respect as many individuals are, as regards other excretions of the body, under similar circumstances. The milk ceases to be secreted when the most powerful stimulant to its secretion, namely, the suction of the child, is withheld, or upon the supervention of pregnancy. (See Lactation.)

When the quantity of the milk diminishes gradually until it disappears altogether, it is often very difficult to re-establish it: the food should be nourishing, generous, and of easy digestion. Acids should be avoided. Rice-milk, porter, and Embden groats in gruel, are recommended; the breasts should be kept warm, and it will perhaps be found useful to excite them by friction. But the best excitant of all is the suction by the mouth of the infant. When these means fail, there is no choice; the infant must be weaned and brought up *by hand*, as it is termed, or another nurse must be provided. When the breasts are ill-formed, or not prominent enough, they should be drawn with an appropriate instrument. But it may not be practicable either to suckle the child, or draw the nipples, in consequence of the sores or cracks accompanying a mastoitis, as in this case the attempts would be too painful for endurance; pressure gently made on the less painful parts of the breast, with gentle suction by a nurse, will be the only means admissible. (See Mastoitis.)

Hired nurses often conceal the suppression of their milk; this may be suspected when the infant becomes fretful, with dryness and heat of skin; the breasts should be examined; if they are found to be constantly flaccid and empty, and that no milk can be obtained by pressure, beyond a drop or two of thin, serous fluid, the milk is secreted in too scanty quantity to satisfy the infant, and will soon cease to be furnished altogether.

AGRIPPA, (*Obstet.*) *partus*, *agripparum*, *agrippinus*, Lat.; derived, say some authors, from *ægre partus*, others from ἄγρα, "seizure," and ποῦς, "foot." Birth by foot presentation. Pliny uses it in this sense. It is pretended that Agrippa owed his name to the circumstance of his having been thus born.

AIDE, *adjutor*, *minister*, Lat.; *assistant*, Eng. The surgeon, in the hospital, operating theatre, and on the field, requires one or more assistants to aid him in the discharge of his duties. The qualities requisite in an assistant are physical or moral. The possession of mere bodily strength to prevent the patient from making any sudden movements, by which the safety of the operation, and perhaps even life itself might be endangered, or to hold the part on which the surgeon is operating, is often sufficient for the necessities of the case. An uneducated man is quite as capable as any other of making counter-extension for the reduction of a luxation, or the adjustment of the ends of a fractured bone. Under other circumstances, however, the assistant cannot be too conversant with all the resources of the art of surgery, as the success of an operation often depends upon the manner in which the operator is assisted. How desirable it would be in many cases, that the surgeon should be seconded by a person, not only familiar with all the details of the operation, but capable of performing it!

The duties of the assistant are various; and where several are engaged in an operation each has his part assigned to him, some being stationed to hold and encourage the patient, others to hand the instruments in the order in which they are required,—to supply sponge, ligatures, or whatever else may be necessary. Such an arrangement is always made a preliminary to the regular operations of surgery. But how much more necessary must these previous dispositions be, when the operation to be performed is one of those irregular, unusual proceedings in which it is impossible for the surgeon to have an idea beforehand of all the difficulties he may have to encounter!

Persons accustomed to hospital practice are best qualified for the duties of assistants, possessing, as they do, the necessary strength and address to make compression on the trunks of arteries, to seize bleeding vessels, put on ligatures, fix the organ in operations on the eye, &c. Their conduct should be regulated with great prudence and discretion, so that, during the operation, no word or gesture escape them to alarm the patient by the idea of unforeseen danger or difficulty; they should be firm enough to bear the sight of blood and the cries of the sufferer. The qualities of an assistant are best appreciated by the surgeons most engaged in the performance of the operations of what the continental surgeons call "high surgery;" they are too often overlooked by persons less conversant with the fulfilment of those arduous duties.

The number of assistants must be regulated by the nature of the operation to be performed; it is proper, in all cases, to limit it to those that are indispensable, more particularly in cases of females, when the operations interest parts, the exposure of which to a crowd of persons, would excite in the patient feelings of shame and humiliation.

(*Wm. B. Costello.*)

ALBUGO, *albus*, Lat.; ἄργεμα, Gr.; a pearl or web, Eng. This word is employed to designate a white opaque spot or stain upon a part or the whole of the cornea, which, in proportion to its extent, destroys its transparency. There are several varieties of these opacities, which will be noticed under the articles Nebula and Leucoma, which differ, however, from the albugo. This affection, which was described by the ancients, Pliny in particular, is most commonly a consequence of violent inflammation of the eye, terminating in the effusion and organization of lymph between the laminæ of the cornea. It is also sometimes observed to be formed slowly, and without being preceded by inflammation, in persons of scrofulous habit, or who are tainted with the syphilitic virus.

The albugo presents the appearance of an irregular spot, the opacity of which sometimes reflects a blueish or pearly colour: the centre is commonly the densest part; but even at its borders, where it is thinner, the contrast it presents with the translucent cornea is sufficiently striking. The colour of the recently-formed albugo is blueish; that of the albugo of long standing, a dead white. Sometimes small blood-vessels can be seen entering its substances; at others, it seems isolated in the midst of the cornea, without any apparent vascularity whatever. Its effects in intercepting the entrance of the rays of light into the eye are easily understood,—effects the more complete, in proportion as the opacity occupies a more central position, or a greater portion of the cornea: when it is spread over the entire cornea the blindness is total. When the albugo is small, even though it be situated in the centre of the cornea, vision is still exercised, as the light passes in at its sides; and in this case, the sight will be best in obscure places, owing to the greater dilatation of the pupil. The albugo produces neither depression nor elevation of the cornea, two states which characterize respectively the former, the Leucoma, the latter pustules on the cornea. It differs also from the Nebula in its being opaque.

The disease depends upon the deposition of opaque lymph in a structure, which, for the due exercise of vision, should be translucent. Whatever, therefore, can give activity to the absorbent vessels of the part will be calculated to remove it. In young persons, in whom absorption is very active, the removal of these opacities is often effected either spontaneously, or in consequence of the treatment adopted. The reverse of this is observed in persons of advanced years. But it should be observed, that their curability depends often on other conditions that have no relation to the age of the person. Where the deposition of lymph is lightest, the cure is, *cæteris paribus*, the most certain; where the deposition is considerable, less so; and where, with the deposition, the laminæ of the cornea have become adherent, least of all, as the cicatrix cannot be obliterated. It is sometimes complicated with staphyloma, and other affections of the globe of the eye.

During the inflammation of the eye the effusion of lymph is combated by the usual remedies. (See Cornea.) When the active state has passed away, topical applications must be had recourse to to excite the absorbents. For this purpose a great variety of substances, of various forms too, have been recommended. That great compiler of remedies, Pliny, boasts of the good effects of the gall of sheep, pike, and barbel, applied to the cornea with a camel-hair pencil three or four times a day; he extols in the same manner various resins: but these remedies are now laid aside. Dry collyria, composed of calcined alum, and sugar finely powdered; calomel and sugar, which Dupuytren used to recommend; nitrate of potass, or oxide of zinc and sugar candy are now used with good effect; they are applied by the insufflation into the eye, of a small quantity once or twice a day, through a quill. Cloquet employs the oxide of bismuth in the same way, a seton being established at the back of the neck at the same time.

Scarpa recommends the following collyrium:—Ammon. Muriat. ℈ij.; Cupri Acetati, gr. iv.; Aquæ Calcis, ℥viij. Misce. The fluid is allowed to stand twenty-four hours, and is then filtered. He praises also the following ointment: ℞ Oxide of zinc, ℈i.; aloes and calomel, a.a. gr. ij.; fresh butter, ℥ss. Jannin's ointment is also employed, with other ointments and washes, in which the nitrate of silver, the sulphate of zinc, the tutia preparata, alum, &c. &c. form the chief ingredient. The topical treatment should be persevered in for three or four months to produce the dispersion of the opacity; and in many cases it cannot be effected by any means that we can employ. (See Cornea.)

(*Wm. B. Costello.*)

ALCALI, a word of Arabic origin, from *al*, "the," and *kali*, the name of the *salsola soda*, a plant which contains a large quantity of one of the principal alkalies—*soda.* The mineral alcalies are employed in surgery; and, in the pure and concentrated state, they exercise the most powerful action on the living tissues, producing vesication, superficial or deep eschars, and even total disorganization, according to the length of time they are allowed to remain in contact with them. On account of this property they are employed for external use in opening abscesses, when the skin has been thinned to a considerable extent, and all but disorganized, to establish issues, to check luxuriant granulations, to arrest phagedenic sloughing, as in hospital gangrene, malignant carbuncle. (See Caustics, Cauterization.)

ALCOHOL, an Arabic word signifying any thing *very subtile, much divided:* in this sense it was formerly applied to fine and impalpable powders. It is now applied only to the products of the vinous or spirituous fermentation. From its great volatility it is employed externally in lotion, as a refrigerant, to check rising inflammation from burns, blows, sprains, contusions, &c.; in fomentations, united with camphor, as a resolutive, tonic, and antiseptic; as a stimulant in syncope, in frictions to the temples, region of the heart, and nostrils; and in injections with water into the tunica vaginalis, for the cure of hydrocele. Harris speaks favourably of its application in cases of erysipelas, painful inflammation of blisters, in gangrene, &c.

ALGALIE, a word of Arabic origin, signifying a tube, or hollow cylinder. (See Catheter.)

ALESE, or ALEZE, Fr. *linteum*, Lat. (from ἀλέξω, "I preserve,") *a guard*, Eng. A name given by French surgeons to a sheet arranged into folds, and thus placed under the patient, in order to protect the bed. Several advantages are secured by the timely use of the aleze, viz., the comfort of the patient who is freed from the contact of pus, sanies, and all excrementitial matters which, if allowed to accumulate, would become offensive and dangerous to health; cleanliness about him is easily kept, and the economy so desirable in public establishments is judiciously provided for. Linen sheets that have been softened by wear and freed from rough seams are the best for this purpose.

The manner of arranging the aleze, in cases where the dejection of excrementitial matter is abundant, and at the same time involuntary, as in serious wounds of viscera, or after parturition, is as follows:—the sheet being already made up into folds, one end of it is carried under the patient, beneath the part where the bed is liable to be soiled, the rest is folded up under the bed-clothes, or left spread across the bed; when the first portion is soiled, it is drawn from under the patient and a clean part takes its place; the soiled part is rolled up, according as it is withdrawn, until the whole length of the aleze has passed under the patient; a fresh one is then procured, and being attached with pins to the first, is drawn under the patient in the same manner. The heads of the pins, used for this purpose should be placed in the direction in which the aleze is drawn, otherwise the patient may be pricked or wounded by them.

When the liquid matter from a wound is so profuse as to be likely to penetrate through the folds of the aleze, the bed should be protected by a piece of oil-cloth which, when soiled, should be changed and washed for fresh use.

Sheets thus folded serve for several other uses in surgery; they are employed in all important operations, such as the amputation of limbs, cutting for the stone, opening abscesses, &c., to receive the blood, urine, or pus which may escape.

ALPHONSIN, a bullet forceps, so named from its inventor, Alphonso Ferri; it is said also to have been invented by Andreas à Cruce. These forceps have been frequently reproduced under various forms, and palmed off as new inventions. In these latter times, Civiale's invention of an instrument for the comminution of stone in the bladder, has been attributed to this source by persons who, with more industry than candour, were desirous of depreciating the importance of his labours. The Alphonsin has served as the model for Thomassini's, Hunter's, and other forceps of this kind, and consists of a tube terminating in three branches, which separate from each other by their elasticity, and which are again brought together and closed, by being received in another tube.

ALUM, *alun*, Fr. *Alaun*, Ger. The name is of Arabic origin. Alum is a salt, consisting of sulphate of alumen with potass and ammonia. It occurs in large, white, semi-transparent masses, or in octahedral crystals, and has a sweetish, astringent taste. Its use in medicine is of very great antiquity, and at one time it may be said to have been the chief ingredient in most external applications. It is employed both internally and externally. As a styptic solution, it is made use of to arrest capillary hæmorrhages from the mucous membrane of the nose, mouth, vagina, and uterus, and from bleeding surfaces. In obstinate epistaxis of young persons the aluminous solution may be aspired into the nostrils, or the alum may be snuffed up, five or six times a day, a few grains at a time, in fine powder. It has been also successfully employed in the form of injection in uterine hæmorrhage persisting after parturition. Smellie recommends a sponge, steeped in a strong solution of alum, to be passed into the vagina. The hæmorrhoidal flux may be checked, when immoderate, in the same way, or by the insertion of a plug well powdered with the alum. In the leech-bites of children it will often stanch the blood, and in situations where the practitioner would prefer keeping cauterization or compression in reserve, a small pointed cone of alum, applied and kept to the bleeding source, will be often sufficient to stop the flow of blood. The hæmorrhage following the extraction of a tooth may be stopped in this way. It is employed also, in very small quantities in collyria, to astringe the vessels of the conjunctiva, when varicose or chronically engorged. St. Ives made use of alum in pterygium and albugo, in the form of a powder, composed of calcined alum, sugar, and phosphate of lime. In powder, with powdered gum arabic, it has been used by insufflation in the back of the mouth, the pharynx, and top of the larynx, with a view to absterge, or detach the membranous flakes that are thrown out in some of the inflammations of these parts, as in the croup, angina, gangrenosa, or diphtheritis. Bretonneau, adopting the views of Areteus respecting the efficacy of alum in arresting these affections, obtained the most signal success in croup, which had ravaged certain departments of France as an epidemic in 1828. The powdered alum was blown into the back of the mouth, on the tonsils, pharynx, larynx, and backwards up the nostrils; this was repeated five or six times a-day, producing retching, and abundant flow of saliva for ten or fifteen minutes. From the first applications, the formation and extension of the false membranes are checked, and in two or three days a favourable termination is induced. This treatment is also successful for the same form of exudation when it occurs on the nipples, external organs of generation, &c.; as well as in the pruritus of these organs.

In the relaxation of the tonsils and uvula, and in the aphthous state of the mouth, it may, united with honey, or in the form of gargle, be advantageously had recourse to. M. Bennati published a work on the utility of aluminous gargles in some states of aphonia; and Dr. Bureaud Rioffrey in his Memoir on Laryngitis bears testimony to its value as a remedy in these cases, and in restoring the vocal powers.

Combined with white of egg and camphorated spirit, it forms a liniment, which is useful as an application to chilblains, and to protect parts from the ill effects of pressure in prolonged decubitus.

When calcined it has slight catheretic properties, and is employed in old ulcers, in which the granulations are pale, soft, cellular, and easily made to bleed; and also in the soft, moist excrescences that arise in the neighbourhood of the anus, and on the lips and inside of the prepuce. When used for this purpose, the parts are slightly powdered over with it; its action as an escharotic, however, is too feeble to be relied on.

(*Wm. B. Costello.*)

ALVEOLES. The cavities in the alveolar process of the superior and inferior maxillary bones, in which the roots of the teeth are inserted. For an account of the diseases of this part, which are intimately connected with those of the teeth, see "TEETH, DISEASES OF."

(*T. Bell.*)

ALVINE, OR ALIMENTARY CONCRETION. A section only of the general subject of FOREIGN BODIES is treated of under this head; namely those to be described hereafter, which are developed in the intestines. The qualitative term "alimentary" will be sufficient to show that we do not in this article include biliary concretions, which are very different in their nature and origin. Mention however will be made of them incidentally as they may become nuclei of the alimentary concretion, strictly so called.

Substances of this description have been occasionally found within the stomach or intestines of man or quadrupeds after death; or they have been discharged during life by the effort of vomiting, or by straining at stool. Such substances are not equally common in every part of the alimentary tube; their most common seat is at the commencement of the larger intestine, near to its termination in the anus, or in the segmoid flexure of the colon, where they have been frequently lodged for a very considerable time, obstructing, to more or less extent, the passage of the fæcal matter, thereby deranging the functions of the digestive apparatus, and ultimately causing great distension of the bowels, which is often succeeded by acute pain, febrile symptoms, inflammation, ulceration, and the death of the animal.

It may perhaps be objected to the term *alvine* that it conveys an imperfect idea of the seat of the obstruction, which is not invariably in the alvus or belly, so that if the term alimentary were substituted for alvine, a more accurate idea would be formed of the seat of the affection.

We speak of salivary, biliary, pancreatic, prostatic, and urinary concretions; and we speak of concretions being seated in the gall-bladder or biliary ducts, of urinary concretions in the kidney, ureter, bladder, or urethra, and therefore we should speak of alimentary concretions in the throat, stomach, and the small and large intestines. Dr. Mason Good, in his Nosology, (page 50,) speaks of enterolithes, from the Greek word ἔντερον, and he makes mention of stony concretions in the stomach or intestinal canal. But his nomenclature appears to me exceptionable, because it seems to me to convey an incorrect idea of the nature of these substances, which, it might be inferred from his note, are formed by a morbid action occasioning the deposition of lime. He says, "Almost all animals are endued with a power of separating or secreting lime and other earths from the blood for particular purposes; as that of forming a shell-covering in insects and worms, and of giving hardness to the bones in other animals. Under a morbid action of single organs, or of the system generally, this is often secreted in an undue quantity, and poured forth into cavities where its accumulation and crystallization must be attended with mischief. Such, at times, is the case in respect to the stomach and intestines."

I have not had the opportunity of examining any concretion found in the alimentary canal which falls precisely under the description of enterolithes given by Dr. Good. It should be observed that the inferior animals, from the nature of their food and their coverings, are much more liable to this affection than man. These concretions are by no means unfrequent amongst horses, oxen, deer, and other quadrupeds that live on grass and other vegetable matter; and, on the other hand, as far as I know, they never occur amongst carnivorous animals. That their production also is connected with the covering of the animal is obvious from the fact that those concretions or balls, as they are commonly called, are by no means uncommonly met with in the stomachs of horses, oxen, calves, and deer, and these are found to be composed chiefly of hairs corresponding in all respects to those on the skin of the animal, and cemented together by the mucus and saliva of the throat. That the kind of food gives a predisposition to the formation of these extraneous bodies, may be inferred from the circumstance that such concretions are much more common in Scotland than in any other part of Europe, oaten bread constituting a principal part of the food of the inhabitants of many parts of this country; a conclusion which seems to derive support from the fact, that these concretions have been but rarely spoken of by the medical authors of Holland, Prussia, Italy, France, Germany, and England.

The museum at Leyden, formed of the joint anatomical collections of Rau, Albinus, Ledeboer, Van Doeveren, and part of the museum of Ruysch, and of the numerous dissections of the pupils of that school, contains, according to Dr. Edward Sandifort, only one specimen of an alvine concretion, and that was found in the ilium.

Dr. Walter of Berlin has published, in three large quarto volumes, a descriptive catalogue of the Anatomical Museum which he sold to the King of Prussia, but has described only one case in which he met with an alvine concretion, "qui inter membranam muscularem et nerveam ventriculi hæsit."

Morgagni has published, in his Thirty-seventh Letter, and Twenty-fourth Article, the histories of several calculi which he met with in the alimentary canal; but from his description of these, I am inclined to suppose that the greater part of them had been formed originally within the gall-bladder, or biliary ducts, and had passed afterwards into the intestinal canal.

He has described very accurately the external characters, and also the internal structure of biliary calculi. He observes, speaking of those calculi found in the intestinal canal, " Interna substantia meros ostendebat circulos striis intersectos ;" and in another passage he adds, " Interius ex circumjectis stratis compactos, et propius centrum ex striis radiatim pergentibus quas inter disjectæ erant albæ splendentesque particulæ." He adds, " Facile pro biliariis habeas." Lieutaud of Paris has described, in his *Historia Anatomico-Medica*, nine cases taken from other authors, in which what he calls *lapides* were found in the stomach ; and, in the 77th page of the same volume, nine cases, also borrowed, in which *lapides* were found in the intestinal canal. Portal, from the manner in which he has expressed himself in the fifth volume of his Anatomie Médicale, seems to have met with only one example of an alvine concretion within the stomach, and only one case of a concretion within the intestines, which he observes was *bileuse*.

In the German Ephemerides, several cases are described, in which what are called calculi were found within different parts of the alimentary canal[1]. Haller has not described a single case in his Opuscula Pathologica. Dr. Baillie, in his Morbid Anatomy of the Human Body, says of calculi in the stomach, " they have never come under my observation, and are to be reckoned very uncommon[2] ;" and he adds[3], " Calculous matter has sometimes been known to be accumulated in some part of the cavity of the intestinal canal, especially in the great intestine ; but this has not come under my own observation, and, at least in the human subject, is a very rare occurrence." And in that very rich repository, the Museum of the Royal College of Surgeons of London, of which a catalogue has been lately published, there is but one specimen of an intestinal concretion, which was taken from a horse.

In the Lithologia of Martin Schurig, published at Leipsic, there are only three or four cases of calculi in the alimentary canal mentioned ; but he quotes from many other authors. He appears to me to have arranged under one head extraneous bodies that have been swallowed, and alvine concretions ; for he names some of those substances which have been passed by stool, or been found within the intestines, *silices*[4], others *lapillos durissimos*[5], others *albicantes*, *rufos*, *griseos*, *tophaceos*[6], and others, as he says, were like biliary calculi. He seems to have met with but one case in which the concretion was like to most of those in the Museum of the University of Edinburgh, which he calls *substantiæ raræ et spongiosæ, magnitudine dimidii ovi*[1].

A complete view of the whole subject of alvine concretions must necessarily include those which are found in the intestines of quadrupeds ; but as that section of the subject would be inadmissible in a work of this nature, we shall confine ourselves chiefly to those which occur in the alimentary canal of man.

Concretions found in the human alimentary canal.—The concretions found in the alimentary canal vary considerably in their physical and chemical properties, and may be classed as follows : The first class comprehends such concretions as are formed of a number of very small vegetable fibres, being composed chiefly of the husk of the oat, held in union by a tenacious mucus ; in some concretions of this description, the centre or nucleus is sometimes found to be a cherry or prune stone, a small fragment of wood or bone, or a little gravel ; and, according to some authors, a small biliary concretion, or a small portion of adipocire. In some, but by no means in all such concretions, there are a few white, thin, concentric, laminæ, which are either phosphate of lime, or the ammoniaco-magnesian phosphate. When such concretions have attained a considerable size they are of irregular shape, sometimes tuberculated, and resembling a mulberry, and sometimes incrusted by a coating of phosphate of lime, or ammoniaco-magnesian phosphate, of two or three lines in thickness.

The second class of concretions, which is much more rare than the first, bears some resemblance to it, being composed of a number of cherry or prune stones or gooseberry seeds cemented together by a tenacious mucus. Concretions of this description have also been described by Mr. Children, (Phil. Trans. 1822,) and he has given a case where such a concretion proved fatal a very short time after the patient had eaten a large quantity of plums.

The third class differs essentially from the two preceding, being composed of vitiated bile, saliva, or pancreatic juice, and are not primarily formed within the alimentary canal, but find their way into it through the ducts proper to the salivary glands, pancreas, or liver.

The fourth class comprehends those concretions which are composed of a cetaceous substance ; they have neither the specific levity, crystallised form, colour, nor bitter taste of gall stones, and are probably formed in the intestinal canal ; an opinion which receives weight from the case of a lady, who, after having swallowed a considerable quantity of olive oil, constantly voided a number of globular concretions, " varying in size from that of a small pea to the bulk of a moderate grape, of cream colour, and slightly translucent, of a sufficient consistence to preserve their form, and to bear being cut by a knife, like soft wax ; the second case, that of a girl four years and a half old, who appears to have had a power of secreting oil in the intestines, and of discharging it per anum. At three years old her mother observed something come from her as she walked across the room, which, when examined, was found to be fat in a liquid state, which concreted when cold. Ever since that time to the present, she has voided at intervals of ten or fourteen days, the quantity of from one to three ounces, sometimes pure, at others mixed with fæces; when voided it has a peculiar yellow tinge, and is quite fluid, like oil. Her appetite and spirits are good, and her flesh firm; her belly rather tumid, but not hard; she is subject to occasional griping."

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[1] Ephem. Nat. Cur. Dec. I. Ann. II. Obs. 89. 130. et variis locis.

[2] Vide Morbid Anatomy, 2d Edition.

[3] P. 194.

[4] Vide p. 191.

[5] Vide p. 154.

[6] Vide p. 154.

[1] Vide p. 157.

Cases of a similar description are recorded in the *Act. Nat. Cur.*, vol. iii., obs. 51; by Dr. William Scott, in the *Edinburgh Medical Commentaries*, vol. iv. p. 334; by Dr. Elliotson, in the *Philosophical Transactions*, 1813, Art. 21; by Dr. Kuntzmaur, of Berlin, (*Journal der Pract. Heilkunde*, July, 1821) and by Dietrick, and several others.

The fifth class comprehends those concretions, the nature of which was discovered by Dr. Kennedy of Glasgow (see *Medico-Chir. Journal* for Sept. 1817), and which Dr. Ure has described as similar in colour to ambergris.

The sixth class comprehends such concretions as are composed of magnesia or chalk, and which have been found in the alimentary canal of persons who for some time have been in the habit of taking considerable quantities of these earths.

The seventh class is that which comprehends those concretions which are described as having been discharged by vomiting by persons who had suffered severely from gout: but of these I know nothing, not having yet seen them.

The last class of concretions found in the human alimentary canal is almost entirely formed of the fibrine of the blood, which is incorporated with a certain proportion of the red globules, and occurs sometimes when the mucous membrane of the intestinal tube has been attacked by acute inflammation, as in severe cases of dysentery[1].

Having given the preceding brief enumeration of the different kinds of concretions which are occasionally found within the human alimentary canal, I shall now direct the attention of the reader more particularly to the consideration of the first class.

The following observations on this class have been made chiefly from the large collection of these substances in the Anatomical Museum belonging to the University of Edinburgh. For the chemical analysis of these substances, I am indebted to those distinguished chemical philosophers, Professors Thomson of Glasgow, Traill of Edinburgh, and Dr. John Davy.

Whether I am correct or not in my notion of the cause of alimentary concretions, I shall not at present stop to inquire; but when once formed, it cannot be doubted, that the bowels would, from the admirable mode in which the performance of their functions is provided for, eventually eliminate them, if the retention and enlargement of those foreign bodies, were not favoured by the perversion of these functions, the narrowness of the intestinal tube, its numerous flexuosities, and the depths of the *valvulæ conniventes.*

Alimentary Concretions:—Number.—It generally happens that one or two concretions only are found in the human alimentary tube, though the rule admits many exceptions. My father, in his lectures, used to make mention of the case of a boy of twelve years of age, in whose colon he could distinctly feel twelve concretions of different sizes, and these were moveable. Dr. Malcolm, of Perth, within these few weeks has favoured me with two, of sixty concretions, which he collected from the same individual. Some of the smaller ones had been discharged by the anus, but the larger were found after the patient's death firmly impacted within the larger intestines; the following is a copy of the letter I received from Dr. Malcolm, when he sent to me the alvine concretions.

"John Bett, shoe-maker, Æt. 21. Has been ill nearly two years, with complaints, which at different periods, had been treated by various medical men, as cholic, hysteria, inflammation, flatulency, &c. &c. During the accessions of his complaint, his sufferings were horrible, and so frequent in recurrence, that he was totally incapacitated for work.

"I saw Bett frequently during these attacks; the convolutions of the intestines could be distinctly felt, swelled and knotty, as from flatus; but touching or handling the knots gave him acute pain. I prescribed for him, ol. terebinth., aloetic medicines, tinct. valerian., &c. without giving him any relief. In September last, whilst taking bitter infusion, calculi began to come away by stool, and have continued to do so till very lately to the number of thirty-eight. He is poor, and consequently his diet has been such as is usual with peasants in Scotland, namely, oatmeal and potatoes, &c. He now enjoys perfectly good health."

This patient died a year after the date of this letter. Leave having been obtained to examine his body, several large concretions were found, firmly impacted within the transverse arch of the colon.

A considerable number of concretions have also been found within the stomach. Lazoni met with ten such bodies, and Bilquer has related the history of the case of an old man, in whose stomach he met with thirty calculi of different sizes. It is right to observe, that these alvine concretions are not so frequently met with in

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[1] A concretion similar to the bezoar obtained from the stomachs of the smaller ruminating animals has been said to have been found in the human stomach, but of this I entertain very considerable doubt. Perhaps this opinion is advanced on some such case as the following:—a boy, sixteen years of age, was in the habit of swallowing hair,—he became a prey to hectic fever, and died; on opening the body, the stomach and small intestines were found to contain masses of hair, arranged in concentric layers; the nucleus of one of those balls was a cherry-stone. (*Journal de Méd., Chir., et Pharm.*, 1779, t. lii.)

Glasgow as in Edinburgh. In the Hunterian Museum of the former, there is a very small collection of alvine concretions, amounting to fifteen only; and Professor Burns has informed me, that in the course of his very extensive practice, "he had met with no case he could ascertain by the progress, or the discharge of the concretion, or by examination after death, to have been one of intestinal concretion; nor had any of his medical friends met with a case of intestinal concretion, which they could establish to be such, by *post mortem* examination."

Physical characters of alimentary concretions: —*Size.*—The size of these concretions is extremely *various*. Some do not exceed that of a garden pea; but others are as large as an orange. My grandfather has described several he met with, as being five, six, seven, and even eight inches in circumference; and from the body of a woman, who consulted my father, a concretion was taken out of the colon, three years after by Mr. Renton, surgeon, in Pennycuick, which weighed four pounds.

Figure.—The large concretions are more irregular in figure than the small; the former have an outer crust, which gives them a very unequal surface; some seem to be made up of a congeries of smaller calculi. This may be probably owing to the additions made to the surface of the calculus during the time it remains fixed within a certain portion of the intestinal canal. Thus a calculus which had been moveable becomes fixed, the convexities on the surface becoming adapted to the concavities within which the concretion has been lodged. Some alvine concretions are perforated by a number of small holes like certain corals. The smaller concretions are somewhat of an oval or spherical shape, slightly flattened at the sides, which is probably occasioned by the friction and pressure of one concretion upon another; and some impress each other so much as to resemble cup and ball. In a case described by my grandfather, in which several concretions were passed, "the largest of the five balls, which was the first voided, was five inches in circumference, and something globular, but with several prominences and flat surfaces. Most of the flat parts had a smooth shining tartarous thin coat; the rest of it was more rough, and of a spongy appearance. The two last brought away were less in bulk, and without so much tartarous crust; the two small ones were all covered over with a shining tartarous crust, which in several places was prettily variegated with different shades of an ashy colour. One of them had some resemblance in shape to the shell of a tortoise; the other, the smallest, to two pyramids, joined by a common base[1]."

Colour.—The colour of the smaller calculi differs from that of the larger, the former having no external coating. The colour of the surface of thirty-five of the concretions in the Museum of Edinburgh, is nearly the same, resembling that of bad yellow ochre of iron; whereas, most of the larger calculi are encrusted with earthy matter, of a coffee or purple colour, and others by white matter which seems to have been deposited in thin successive layers.

Structure.—The human alvine concretions which were collected by my father, are, with a few exceptions, similar as to structure; all are more or less porous, and somewhat like dried sponge; when examined by the aid of a good magnifying glass, they seem to be made up of a number of very small fibres, intimately interwoven with each other, like those in a hat, or in chamois leather, and the interstices between the fibres are filled up by earthy matter.

In consistence, these concretions resemble dried sponge, and, like it, may be cut with a sharp knife; but when a blunt knife is used, the dried concretion crumbles to pieces. There are small holes on the surface of a few concretions, which pass for about half an inch into the substance of the calculus; and in one of the specimens there were twelve cavities of a cylindrical form, which penetrate as far as the very centre of the concretion, and were filled with a viscid mucous.

The external crust of the larger concretions seldom exceeds two or three lines in thickness, and is deposited in layers, which when dry are friable, and apt to split and crack off. In some of the specimens the external earthy crust covers only a part of the calculus. Upon making a section of most alvine concretions, they are found to be composed of distinct layers of a yellow or brown colour, but in some the layers do not pervade every part of the calculi; in some, there are no layers observed. But those found in the deer form an exception to the above observation, for some have a radiated structure, like biliary calculi. The lamellæ, which are about two lines in thickness, are generally of a lighter colour than the rest of the calculus, but sometimes they are darker. The external form of the calculus seems to determine the course of the layers, or *vice versâ*. If the calculus be of an oval shape, the component layers of it follow a similar direction; the surface of the layers is disposed so as to correspond in its course with the irregular surface; the lamellæ, upon a minute examination, do not form one continued line, as in biliary or urinary calculi. In the centre of the concretion, a prune or a cherry-stone, or a small piece of bone, or a biliary calculus, is generally found. Upon a minute examination of all sections of the human concretions, which are collected in the museum of the University of Edinburgh, a nucleus may be distinctly observed. In some of these concretions the nucleus is large and very easily seen, being a plum or cherry-stone, or a fragment of wood or bone; but in the majority, the nucleus is small and not very apparent, and looks very like a number of particles of common sand, held together by a viscid mucus.

In some there are cavities, filled by small grains of sand adhering to each other by several small fibres. In the upper part of some of the concretions many distinct white shining crystals are visible. By exposure to the air, the internal part of the concretion acquires a darker colour.

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[1] Vide Quarto edition of his works, p. 668.

From what has been stated as to the structure of alvine concretions, it is probable that these substances are formed upon an extraneous body, and also that they increase in bulk, in consequence of the deposition of successive strata; and as such they are justly called concretions, being composed of parts of the food or other substances, deposited in their passage through the alimentary canal.

In order to throw farther light upon the nature of concretions of the first class, I subjoin a description of the more common kind, drawn up according to the manner of Werner, by my colleague, Professor Jameson:—

"No. 1.—*Colour* of the cut surface, intermediate between yellowish brown and chesnut brown; *shape*, tuberose, and perforated; *lustre*, dull; *fracture*, delicate, promiscuous fibrous; *transparency*, opaque; *streak*, not altered in the streak; *hardness*, yields readily to the nail, and receives an impression from the finger; *tenacity*, sectile; *frangibility*, difficultly frangible; *feel*, feels fine and rather meagre. Is light.

"N. B.—The external shape is coated with a dark brown coloured crust, which is soft, brittle, resinous in the streak, and light. Some parts of this crust are covered with an ash-grey coloured crust, which is softer than the brown crust, and is sectile.

Chemical analysis of alvine concretions.—Morgagni[1], Van Swieten, Lassus[2], and Richerand, have supposed these substances to be indurated fæces.

Cadet[3] and Portal[4] are the only authors whose experiments on this branch of the subject merit mention. But Cadet made his experiments when chemistry may be said to have been in its infant state, for chemical analysis had not arrived at the perfection it has now attained; and I must doubt whether Portal was sufficiently qualified as a chemist for undertaking the analysis of such compound substances as alvine concretions; and whether his experiments were of such a kind as to enable him to draw just conclusions respecting their nature. If the experiments of Cadet, who was a distinguished chemist of his day, were rude and imperfect, we may reasonably infer that those of Portal are liable to still greater objections.

Under these circumstances I thought it of great moment that some competent modern chemist should examine the large collection of alvine concretions formed by my father, with the view of determining whether they are merely the indigestible part of the food, or an agglutination of the various substances licked off, from the animal's skin, earth or any other substance the animal may have chanced to swallow along with its food, or substances *sui generis*, and totally different from any other animal or vegetable production.

In the collection above alluded to, there are forty-two specimens of alvine concretions which were obtained from the human body, several of which I was so fortunate as to prevail upon Dr. T. Thomson to examine. His labours have thrown much new light upon the subject, as the reader will find from the annexed report which he sent me.

"The calculi which I examined are of a much more compound nature than I expected, and contain two substances, of a nature quite peculiar, or at least with which I was not before acquainted. The following observations will convey a general idea of their nature and composition.

"1st. At first, they swim in water; but that is owing to their numerous pores being filled with air; as soon as it is expelled, they sink to the bottom and remain there. The specific gravity I found to vary in different specimens, from 1·376 to 1·540. I consider 1·400 as about the average specific gravity of the whole.

"2d. When left in cold water they soon communicate to it a brownish tinge. The water was found to have taken up the following substances:—1. Albumen, which was separated in white flakes by boiling the water. 2. A brown substance, which I consider as peculiar; it dissolved, at first, in water, but became nearly insoluble by the slow evaporation of the liquid; it dissolved in alcohol; it approached most nearly, in its properties, to vegetable extractive; but the quantity which I obtained was too small for an exact examination. 3. Common salt, which crystallized when the water was allowed to evaporate spontaneously in an open vessel. 4. Phosphate of lime, which was precipitated by ammonia. 5. Sulphate of soda, in a very minute proportion. 6. Perhaps, also, sulphate of lime; but the quantity of this salt must have been very small.

"3rd. Alcohol dissolved the peculiar brown matter, and some of the salts, but extracted nothing particular.

"4th. Potash ley separated the albumen, the brown matter, and perhaps some of the salts.

"5th. Muriatic acid separated a notable proportion of phosphate of lime.

"6th. After the action of all these re-agents, there remained behind a peculiar substance, having the colour and texture of the calculus. Ten grains of calculus left 1·2 grains of this matter; it was very light, having the appearance of cork, or rather, of the peculiar fungus, which is used on the continent for tinder, and which the French call *amadou;* it was in very short threads. This substance is tasteless, insoluble in water, alcohol, æther, potash ley, and muriatic acid: it blackens sulphuric acid, and is dissolved, being partly reduced to charcoal. In nitric acid it dissolves very slowly, and only when assisted by heat, and hardly effervesces. When the solution is evaporated to dryness, a whitish residue remains, which has a bitterish taste, and is imperfectly soluble in water. Nitric acid does not convert it into any of the vegetable acids, though digested on it repeatedly. This substance burns with a slight flame, and rather like a vegetable than an animal body. It is undoubtedly of a peculiar nature, differing from every animal and vegetable substance hitherto examined. Its insolubility in potash ley distinguishes it readily from wood. It has no resemblance to any animal substance whatever.

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[1] Epist. 37.

[2] Patholog. Chirurg.

[3] Mém. de l'Acad. Royal. de Chir. tom. iii. p. 15.

[4] Anat. Méd. tom. v.

"7th. The calculi consist essentially of alternate layers of this peculiar substance, and of phosphate of lime. Sometimes the substances are intimately mixed, instead of being in alternate layers. The albumen and brown matter seem to serve as a cement; the other substances are in a small proportion. The crust on the outside of some of the calculi consists of phosphate of lime, mixed with a brown animal matter. In a few specimens I observed crystals of phosphate of ammonia and magnesia, upon the outside crust of the calculi; but these appearances are uncommon.

"Such are the constituents of the concretions as far as examined. In two calculi the phosphate of lime amounted to rather more than half the weight of the whole. In one specimen the albumen separated was one twenty-seventh of the whole; but I have reason to believe that a portion still remained. The quantity of common salt and sulphate of soda was small. I could detect no potash by the test of muriate of platinum. Neither was there any ammonia sent, or carbonate of lime, both of which I expected to find. I examined the calculi carefully for uric acid, but found none. Neither could I detect any urea, substances abounding in urinary calculi.

"The preceding details are sufficient to show, that the calculi in question are of a very different nature from any hitherto examined. They are of a much more insoluble nature than urinary calculi; indeed, no solvent exists, except of a nature so corrosive that it could not be applied."

Dr. Thomson examined five of these concretions, Dr. Traill one: the several specimens underwent different treatment—some of the results are selected. Of those examined by the former gentleman, No. 1 furnished, in 100 parts, 78·0 fibrous matter: ·5 yellow colouring matter: 21·5 saline matter.

No. 2 furnished 7·0 grs. saline matter: 1·4 brown fæcal matter: 17·2 resinous matter: 74·4 fibrous matter. In the other three, the relative proportions of these elements fluctuated.

In Dr. Traill's analysis (proportions not exactly stated,) the result was—1, vegetable hairs, or filaments; 2, mucous, or muco-extractive matter; 3, magnesia; 4, lime. "The first," says Dr. Traill, "forms by far the principal part of the calculus; the second is the cement that binds these together, aided by the small quantity of magnesia, and still more minute quantity of lime.

"This intestinal calculus seems to me to be precisely similar to those described by (I think) Wollaston, as derived from oatmeal. It is not, as has been supposed by some, the beard or awn of the oat, that contributes to their formation; but if we separate the whole husk of the oat we find, on the upper end of the farinaceous part of the seed, a beautiful silky *tomentum* or down, which, when put under the microscope, has the same appearance as that contained in the calculus, and has similar dimensions, both as to length and diameter."

From the preceding details it appears that, in different specimens, the composition of the alvine concretions varies, both as to their saline and their inflammable contents. The fibrous matter which they all contain seems, as Dr. Thomson, who first examined it, considers it to be, a peculiar substance; that obtained from the two first concretions being soluble in potash, approaches, by one step nearer, to woody matter, but it widely differs in the effect which heat produces, intumescing, and not retaining its form like wood. The resinous matter which the second contains may be also peculiar, but for this to be satisfactorily proved farther experiments are yet required. The analysis of these concretions throws, if any, but a very imperfect light on their formation. The most probable conjecture appears to me to be, that they are produced from the remains of the ingesta, during their stay in the large intestines. On this hypothesis there would be no difficulty in accounting for the saline ingredients, all of which exist in the fæces; neither would there be any respecting the formation of the resinous substance found in No. 2; it is, moreover, easy to conceive, and most natural too, that the fibrous matter, like the saline, is derived from the food. In opposition, it may be said, that the fibrous matter is a new substance; but, let this be granted, and it may nevertheless be contained in vegetables, and it would be desirable to examine those in most common use, with this object in view. The idea of the formation of these fibres in the intestines, from chemical changes there taking place, is difficult of conception, but the idea of this secretion is still more so.

It is deeply to be regretted that no clue is derived from analysis to assist us in their successful removal, during the life of the patient. Their size, in general, is so great before they create afflicting symptoms, and their solubility, even in the most active menstrua, so slight, as to banish all hope of relief from this source, however gravely it may be asserted in the *Dictionnaire des Sciences Médicales*[1], that biliary calculi, and intestinal concretions, may be dissolved by the use of fresh vegetables.

Since these analyses of alimentary concretions were made, experiments as to the chemical nature of these substances have been published by Dr. Marcet, Robiquet of Paris, and Drs. Ure[1] and Turner of London[2].

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[1] See *Dictionnaire des Sciences Médicales*, article 'Corps Etrangers,' t. vii., page 6.

According to Marcet, concretions, from the alimentary canal, consist of—in 100 parts, 25·20 animal matter; 3·90 resin; 5·16 ammoniaco-magnesian phosphate; 45·34 phosphate of lime; and 20·30 vegetable fibres. The vegetable fibres were cemented together by deposits of earthy matter.

Causes which give rise to the formation of concretions in the alimentary canal.—In the commencement of this article we alluded to some of the causes that favour the retention and increase of these concretions. The greater number of them being composed of fibres of the indigestible part of the food, of particles of sand, clay, or other extraneous bodies, and being most frequent in Scotland and Lancashire, where a good deal of oaten cake is used as food, it is legitimate to infer that this kind of food gives origin to the formation of such concretion. But this fact is not alone sufficient to account for their production, because, if it were, all persons that take such kind of food would be liable to suffer from the disease.

Two other causes are therefore probably superadded, viz.—a very weak state of the function of digestion, and also the presence of a nucleus which has been swallowed, and is retained for some time within the alimentary tube, the mucous coat of which is thereby much irritated, and its vessels, instead of secreting a healthy mucous fluid, secretes a very viscid mucus, which cements together the different indigestible particles that have been swallowed.

After a small concretion has thus been formed, it rapidly increases in bulk, in consequence of successive layers being added to it.

Among the higher orders of society, the taking magnesia for some time has often occasioned much irritation and derangement in the functions of the alimentary canal, because, when this magnesia does not meet with an acid to favour its discharge by stool, it meets with fresh quantities of the same earth, and a concretion is at length formed, which, in some instances, has attained very considerable bulk. It seems not unimportant to attend to these causes of the formation of alimentary concretions, because they show—1. The pernicious effects which sometimes result from swallowing cherry stones, or those of other fruits, or the seeds or husks of fruits, small fragments of bone, pins, and other extraneous substances. 2. The risk which individuals, afflicted by this disorder in its milder forms, when the concretion within the intestine is small and moveable, and may be discharged by the anus, incur, from continuing to live on oaten bread, or other kind of food which is indigestible, and may afford additional matter to the concretion. 3. The impropriety of giving horses the refuse of the flour, which is mixed with sand or particles of clay, a practice common amongst millers: and, 4. They prove to the grazier the necessity of rubbing the skins of oxen, cows, or calves, so as to remove all loose hairs, which the animal otherwise might lick off and swallow, and which, by concreting, form a nucleus, or add to the bulk of a small concretion within the alimentary canal. Lastly, in the case in which there is reason to suspect that where the concretion formed within the human alimentary tube consists chiefly of magnesia, the growth of it may perhaps be obviated, by giving up the use of magnesia, or by giving diluted sulphuric acid, which prevents the formation of such concretions, as, when combined with magnesia, it proves a purgative salt; such a precaution may, however, be deemed superfluous, as magnesia is generally given to remove acidity of stomach.

It is also evident that those concretions which consist of coagulable lymph, and which are not unfrequently found in the intestines of persons who have died from dysentery, are occasioned by inflammation of the mucous membrane of that tube, and the formation of such concretions may be obviated by the antiphlogistic regimen.

The formation of those concretions which contain a good deal of oily matter, has been imputed to oleaginous matter which has been swallowed, and which has not undergone the necessary changes within the *primæ viæ*. It is not improbable that they are formed by the secretion of an oleaginous substance, or by a chemical change on the fæculent matter after it has passed into the caput cæcum coli, or colon, for fat, in a concrete state, or in a state of fluidity, has occasionally been discharged by stool, by persons of different ages.

Of the Symptoms.—Substances in their course through the alimentary canal may not excite any symptom whatever; or they may be accompanied by sensations of extreme anguish. Alvine concretions prove a source of much irritation, and impair the functions of the stomach and intestines, exciting pain of variable intensity, sensibility of the entire abdomen, nausea, and severe vomiting; distention of the alimentary tube, inflammation, looseness with much griping, or constipation with tenesmus and tormina; hiccup, &c., the symptoms having a general resemblance to those produced by a strangulated hernia. The pain in the bowels is, in some cases, fixed to one part, being much more severe at one time than another, especially after taking acids, or food of difficult digestion; the ingestion of these substances is frequently followed by nausea and vomiting; dry skin; furred tongue; quick pulse, and other febrile symptoms, which, however, are transitory. Some patients are constipated for two or three days, and have, notwithstanding, a constant inclination to go to stool. Such is the case, more particularly, when the foreign body is stopped in the colon, or rectum, the fixed position, and distensibility of which, favour its stoppage. In these cases, there is not only the impossibility of voiding the excrements, but sometimes the urine itself is retained. The belly is meteorized, the colic pains and vomiting are severe; sometimes there is hæmorrhage, or oozing of purulent matter from the anus; if no remission of the symptoms can be procured, enteritis, peritonitis, and gangrene, supervene. Others have watery stools, and discharge with them a quantity of viscid ropy mucus, or blood, after which they are much relieved. Some patients who for years have been afflicted by this disorder, suffer much from a burning sensation at the pit of the stomach, and some discharge their stools involuntarily.

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[1] *Vide* Dr. Ure's *Chemical Dictionary.*

[2] *Vide* Dr. Turner's *Chemistry.*

Upon relaxing the parietes of the abdomen, a very hard, painful, globular tumour may generally be felt at the origin, or in the course of the large intestines; and very often at the sigmoid flexure of the colon.

The concretion is generally immoveable within the intestine; but often appears to change its place in consequence of the change of place of the intestine which contains it. Hence the change appears greatest where the concretion is in the small intestines, or arch of the colon, which, from the length of mesentery, or meso-colon, are very moveable. The digestive powers being in the progress of the disease much impaired, the patient becomes very weak and much emaciated; until at length from the continuance of the disease, he is reduced to a skeleton. The pulse, in the earlier stages, is but little affected.

When the disease has been of some duration, the pain in the bowels is constant.

Concretions have, in some cases, remained for years before they have been dislodged. When they are very large, and lodged, either in the transverse arch, or sigmoid flexure of the colon, they may be distinctly perceived. When the concretion passes into the rectum, it creates excruciating pain in the region of the pelvis and fundament, especially when the patient goes to stool, and the extraneous body may then be perceived during the effort of straining at stool, an inch or two above the anus; it will also be visible when the patient is sitting, or when the constipation has lasted several days.

In the more fortunate cases, the concretion, after exciting severe nausea and vomiting, has been ejected along with the contents of the stomach, or discharged by stool, or extracted from the rectum. It is not a little remarkable, considering the bulk of some of these concretions, that the intestinal canal is not, more frequently, completely obstructed. In the progress, however, of these cases the functions of the intestines become more and more deranged, and so much obstructed, that laxatives by the mouth, or clysters, are necessary to procure a passage.

Tumours occur in the tract of the alimentary canal from a variety of causes, the precise nature of which, if not ascertained, may lead to the most baneful consequences. I shall, therefore, enumerate some of the causes of those tumours which may be mistaken for concretions.

Amongst those which are most readily mistaken for alvine concretions, are masses of indurated fæces. Tumours of the omentum, or mesentery, incipient dropsy of the ovaries, anormal position of one of the kidneys, and scirrhous pylorus.

The following cases are submitted with a view to elucidate this point of diagnosis:—

Case 1.—I was desired by the late Dr. Kilgour of Musselburgh, to visit a man of seventy-three years of age, much emaciated, suffering very acute pain in the abdomen, which was much increased on pressure, and who had had no passage from his bowels for several days. His pulse was quick and hard. The relations informed us that he had been for many years subject to costiveness and stomach complaint. Upon examining the abdomen, several hard substances were distinctly perceived by the touch, a little above the left ilium; these hard substances, it was stated, had been distinctly felt by Mr. Cunningham, surgeon, at Tranent, and also by themselves, for eight or ten years.

Venesection, and large doses of purgatives were employed, but in vain; the patient died in six days after I visited him.

His body was opened by my assistant, Mr. Fyfe, in the presence of Dr. Kilgour and myself. All the viscera of the abdomen were found in a sound state, excepting the sigmoid flexure of the colon, on which there were several black spots; it contained a mass, which, on being minutely examined, proved to be fæces, very much indurated, and collected into a number of hard round tumours.

Case 2.—I was desired by Dr. James Anderson to visit a woman between thirty and forty years of age, who had had for three years a hard tumour about the size of a large orange, resting on the right ilium. The tumour, on pressure, could be made to change its place, but the attempt always gave a good deal of pain. She had had two children since this tumour had been first observed. The functions of the alimentary canal were not in the slightest degree deranged, and hence I was led to impute the swelling to incipient dropsy of the ovarium.

James G. Stirling, aged eight years, Oct. 24th, 1813,—about four months ago was attacked with pleurisy, for which the usual remedies were had recourse to, with success; immediately after this, there was accidently discovered in the right iliac region, a circumscribed tumour of very considerable magnitude, which gave slight uneasiness on handling it. The tumour seemed somewhat moveable, and was at times more distinctly felt, than at others. A course of laxatives was administered without any effect on the tumour; mercury was also used to a considerable extent, both externally and internally, with no effect on the tumour. After the mercury had been some time given up, the bowels being regular, and the child gaining strength, he was suddenly seized with a fit, during which he could not articulate; after this, he had evidently lost the power of voluntary motion of the right arm and leg, to a considerable degree; he became dull, had frequent vomiting, stupor, and other symptoms of hydrocephalus, which terminated in death on the 22nd of October. On opening the abdomen, the intestines appeared in a perfect state. On removing these from the right side, the caput coli was found higher up than usual, and partly behind *and between it and the groin*, the tumour was discovered which had occasioned so much anxiety to his attendants during his life. This tumour lay behind the peritoneum, which being removed carefully, a kidney of three or four times the natural size was brought into view. The ureter was very large, issuing from the pelvis of the kidney, but soon contracted to its usual size: it run across the psoas muscles, and was inserted into the bladder about the usual place. On examining the left side there was not a vestige of kidney or ureter. The bladder was much distended, and reached to the upper end of the kidney.

When the scirrhous pylorus is lower down in the belly than usual, which very frequently happens, it may readily be mistaken for a concretion in the intestinal tube, being a hard moveable tumour, and accompanied by great derangement of the functions of the stomach and intestines. I have been consulted where a tumour originating from this cause was seated near to the navel, and was supposed to be an intestinal concretion.

From what has been stated respecting the effects of alvine concretions upon the alimentary canal, it follows, that these may at first be moved from one part of it to another, but they at length become immoveable, a circumstance which merits the most particular attention, as it marks the progress of the disease, and points out the chance there may be of dislodging the concretion.

In consequence of the increasing bulk of the concretion, the obstruction of the intestines become daily greater and greater. Inflammation and febrile symptoms follow, and end in death.

Appearances on dissection.—In the milder cases, the intestines are found to be considerably dilated, above the place where the concretion has been lodged, and in some there is a distinct sac, the coats of which attain a considerable thickness. In one instance, the ilio-cæcal valve had disappeared.

The mucous membrane of the sac was much thickened and corrugated, so that the cavity which lodged the concretion seemed to be formed by a dilatation of the extremity of the ilium. The villi on the mucous membrane were not perceptible. Owing to the irritation of the concretion, the intestine is sometimes found contracted above and below the seat of the concretion; and in the cases described by Monro, Turner, and also by Horstius, the concretion adhered to the inner surface of the sac. On some occasions, where death has been occasioned by inflammation, consequent to the obstruction caused by the concretion, the inflammation has not been confined to the intestines, but has been found extending over the surface of the peritoneum, together with an effusion of coagulable lymph, and the different turns of the intestine in the vicinity of the concretion have been found adhering to each other, and to the neighbouring bowels. In a very few cases, ulceration of the intestinal tube has been detected allowing the concretion to make its way into an abscess. Such cases have been described by Marcet and Penada.

Treatment.—It has been already observed, that concretions lodged in the stomach have been occasionally discharged by vomiting, and those in the intestinal tube by the anus, especially when they are of a small size, and there is reason to expect the latter favourable issue, where they create considerable pain in sitting, or upon going to stool, which is a proof that the concretion is lodged in the rectum, a fact which may be ascertained by an examination by the finger, or a bougie passed into that bowel.

Concretions impacted within the alimentary canal generally give more or less uneasiness in proportion to their bulk, and when they give rise to severe colic, pain in the iliac region, or top of the os sacrum, constipation alternating with diarrhœa, or obstinate costiveness, much relief is given by the application of warm fomentations to the belly, and by emollients, into the composition of which warm olive or castor oil enters; and in order that they may fulfil their intention more effectually, the clyster is to be administered, whilst the patient rests on his knees and elbows, with the pelvis raised above the shoulders. Should the symptoms be more urgent, accompanied with febrile disturbance, the same mode of treatment is to be adopted as in cases of inflammation. When the symptoms subside upon the discharge of the concretion by the anus, the disease has probably been removed; but as in several cases there are two or more concretions lodged in the intestinal tube, the patient's case should be attentively watched. As concretions have been occasionally discharged by vomiting, emetics have been recommended; but though those of the milder description may not do harm, the more acrid may bring on ileus. Mention has been made by some writers of attempting to dissolve concretions lodged within the stomach or intestines; but owing to the nature of these substances there seems to me to be no prospect of relief from such a class of remedies; and I am not acquainted with any remedy which possesses, in the slightest degree, the property of dissolving the concretion, which would not materially injure the mucous membrane of the alimentary tube; so that much more is to be expected from the use of oily and emollient purgatives, combined with clysters; and these must be persevered in for a considerable length of time.

In the first and second editions of the book

I published many years ago, on the morbid anatomy of the gullet, stomach, and intestines, mention has been made of this mode of treatment, which was proposed by my father, and of which succeeding authors, particularly Dr. Copland, has spoken in laudatory terms.

The following is an extract from my book, and contains, in a letter to Sir A. Douglas, the history of one of the cases in which this mode of treatment was adopted.

"*Edinburgh, Nov.* 28, 1768.

"Sir,—Having carefully examined and considered Mr. M.'s case, I am altogether certain that his complaints proceed from a concretion lodged within the left side of the colon, of the same kind probably with those he passed some years ago, and of which I have in my possession about *thirty*, taken from different patients.

"As it is impossible to reach it from the anus, so as to extract it with a pair of forceps, the patient should carefully observe the following directions, by which it is hoped he may in no long time pass the concretion, or bring it past the turn of the colon into the rectum, so that it may be got hold of with an instrument, and extracted.

"He ought to take every night, at bedtime, a tea-spoonful, or as much of the lenitive electuary as shall be found sufficient to procure one loose stool; and in the morning a clyster, composed of an English pint of warm milk, to which two table-spoonsful of olive oil are to be added; and this should be retained for an hour, if possible, by lying in bed, with the buttocks raised by pillows.

"When he goes to stool, he ought, with his hand, to push the concretion downwards as far as he can, without raising considerable pain, and to sit over the steam of hot water, making efforts longer than is commonly necessary; and even when he is not at stool, he ought frequently through the day to work it downwards with his hand; and by squeezing as if he were at stool, or by putting his finger, or a feather, into his throat, to occasion such an effort as is made when we vomit.

"Once in ten days, or oftener, he should take a purgative, and on the evening of that day a laxative clyster; and when the clyster begins to operate, let him take an emetic, and go into the warm bath. A dozen or two of pills, made of Castile soap, in a table-spoonful or two of oil, taken every day, may probably be of considerable service. A flannel-shirt should be worn, and through the day a piece of fur should be laid upon the tumour. His diet ought to consist chiefly of bread, milk, soup, or broth, with a little fowl, jellies, or plain roasted or boiled meat. Moderate walking, or riding on horseback, will be of service; but fatigue is to be avoided. I believe I need not add, that excess in eating or drinking might prove highly dangerous.

"No chirurgical operation is to be performed, unless the concretion should altogether stop the passage through the guts, so as to bring on dangerous symptoms, such as could not be removed by medicines. In that case, indeed, an operation, though very dangerous, might be necessary."

The following year my father received the subsequent letters from his patient.

"*Dundee*, 20*th Feb.* 1769.

"My disorder rather increases. I am in continual pain; my appetite is quite gone; I get no sleep but from opium, which undoubtedly will soon reduce me very low; indeed, I am so already. The concretion still remains in the same place. In March I found the tumour a hand-breadth lower than it had been in November.

"I am, &c., John M."

Upon this letter my father wrote the following memorandum.—"In March the tumour was a hand-breadth lower than it had been in November, or half-way between the anterior spinous process of the ilium and the os pubis.

"Instead of the former clyster, I recommended an infusion of linseed with oil, and to throw in as much as his guts would receive. He found that he could receive a chopin of it, and thought it reached as high as the tumour.

"I prescribed the following mixture:—℞ Mannæ ʒ iij.; Vitel. ovi ʒij.; Olei olivar. ℥ss.; Misce, dein. adde sal. Glauber. ℥j.; Solut. in aq. fontan. ℥ vj.—He took this purgative in the morning, once a-week; at night the clyster, and then the emetic, and passed the clyster in time of the vomiting.

"'*Dundee*, 2*d April*, 1769.

"'Upon feeling for the lump yesterday, to my surprise I found it quite away from the lower part of the groin, where it used to give me much pain from every thing that passed it. Ever since, I have suffered great pain across the fundament; and I have passed nothing these two days and nights. I cannot throw up one-sixth part so much of the clyster as I used to do, and that gives me much pain. I am continually very thirsty, have a great pain across my stomach, and the parts there are all extended more than usual. I took physic this morning, but it has not produced any effect. There is a very great rumbling in my stomach; the wind, &c., roll about continually, but do not come lower down. I cannot eat any thing. Pray, let me have your answer in course.

"'I am, &c., John M. Jun.'

"'P. S. Since I wrote the other side, I have been seized with a violent vomiting.'

"This gentleman died before my answer reached Dundee, on the 24th of April, 1769.

"After his death a very large concretion was found in the lower part of the sigmoid flexure of the colon."

Of the mode of cure by a surgical operation.—There are two different methods by which an extraneous body may be removed from the intestinal canal. By the one the extraneous body is extracted by a pair of large blunt forceps after the rectum has been dilated; by the other, an incision is made into the intestinal canal. It is obvious that the former of these methods is applicable only when the concretion is lodged within the rectum, and a few inches above the sphincter ani. This method of operating was practised successfully by Monro primus. In one case, after the extraction of a large concretion, the patient passed two others. The same operation has been performed with success by Mr. R. Marshall, Mr. Mein, of Dunn, and by Mr. Goodser, of Largs.

Operation for the extraction of concretions in the alimentary canal by incision.—There has been some difference of opinion as to the most fit place for making an opening into the intestinal tube. The mode directed by my father, who was the first to recommend this operation, will be found in the following extract :—

" If the concretions shall, by increasing, or by change of place, obstruct and stop the passage entirely, it is, I apprehend possible to save life by taking them out by an operation ; for, as the colon is, on its back part, not covered by the peritoneum, but connected by cellular substance only to the muscles, if an incision be made on the posterior part of it, between the twelfth rib and upper part of the ilium, or immediately above the ilium, *the colon may be opened, without opening into the cavity of the belly ; and the wound, I have little doubt, could be cured without much danger, especially as, in the course of last year, I have seen it in one case wounded by a pistol ball, and in another eroded at this very place ; and yet in both the openings were healed soon.*

" The operation may be performed in the following manner :

" Let an incision be made from the twelfth rib, at the distance of two inches from its point, directly downwards to the top of the os ilium. Then cut slowly, and with great caution, inwards and forwards, till the back of the colon is laid bare for a little way. Then, with one hand, press on the fore part of the tumour, and, with a finger of the other hand, try whether you feel the tumours within the colon. If you think you do, make a very small hole in the colon, and introduce a probe ; and, by that means, make it certain that the balls are there by touching them with it. Then, with the greatest caution, enlarge the incision as much as is necessary for introducing a pair of forceps, such as are used in lithotomy, for laying hold of and extracting them. After they are extracted, and the fæces that may be collected there are pressed out at the wound, let the sides of the incision be pressed together, and let the external part of the incision be stitched, by sutures passed through the skin, at the distance of a finger-breadth from each other. Cover the stitches and incision with straps of adhesive plaster, and with thick pledgets spread with ceratum simplex, and with a compress and bandage, so as to exclude the air."

The proposal of making an artificial opening into the sigmoid flexure of the colon, in order to remove the extraneous body lodged within that bowel, is grounded on the results of the experiments of Mr. Pring, who, in different instances of disease affecting the rectum and obstructing it, has recommended the making an artificial anus in the groin [1].

A third mode of operating by incision has been recommended by Mr. Tortel, viz. the cutting immediately down upon the intestinal concretion, on the supposition that the risk of exposing the peritoneum and intestinal tube has been much exaggerated. But though experiments upon animals — and especially many experiments which were made last winter by my assistant, Mr. Fyfe, have proved —that exposing the bowels, and even removing a portion of them, does not invariably prove fatal, still I apprehend that the method of operating proposed by my father is not fraught with the same extent of danger, as the cutting down immediately upon the concretion lodged within a part of the intestinal tube.

The preceding observations appear to me to have established the following propositions : —1st, That the greater number of concretions found in the human stomach or intestines consist chiefly of fibres of the beard of the oat, which are intimately matted together, and which probably have accumulated round a central nucleus.—2ndly, That they occasion a derangement of the functions of the alimentary canal, and create griping, obstinate and long-continued colicky pains, which are generally limited to that part of the intestinal canal which contains the concretion, and which are occasionally more severe upon the patient taking acids, or food of difficult digestion.—3rdly, That they may be generally felt within the intestines ; and when two or more of these are lodged within the intestines, they may be made to strike against each other.—4thly, That they frequently change their situation, and pass down into the rectum, which is thereby much extended, and, when so situated, occasion acute pain and sense of weight in the back part of the pelvis, with a constant desire to go to stool, which the patient cannot gratify ; and they may, by the finger, or by an instrument passed into the rectum, be felt within it.—5thly, That they are, in some cases, discharged by vomiting, or along with the fæces. —6thly, That an intestinal concretion, after a certain time, cannot be moved from one portion of the alimentary canal to another, owing to its increase in bulk, to the expansion of the coats of that part which contains the concretion into a sac, and to the unnatural constriction immediately below it.—7thly, That they offer a mechanical obstruction to the passage of the aliment through the intestines ; and if proper means be not taken to remove the cause of the obstruction, inflammation of the intestines follows, which proves fatal.—8thly, That, in the earlier stages of the disease, while the concretion may be moved from one part of the intestines to another, all that can be done is, to operate on the bowels, partly through the medium of mechanical action, and partly by lubricating the alimentary canal by the exhibition of proper medicines, in order that the concretion may be discharged along with the fæces, or may descend into the rectum, from which it may be artificially extracted.—9thly, That after the disease has been of long standing, and when a sac has been formed, which retains the concretion in a certain place, it cannot be removed, should it be lodged within the colon, but by an incision, as there is no chance of dissolving it by any medicine given internally.

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[1] Med. Intel. No. 28, p. 61. Feb. 1822.

In conclusion I may remark, that it would be extremely desirable, should any favourable cases occur, to have this operation subjected to a fair test of experiment. Under such circumstances it would be for the operator to reflect how far his success might be promoted by inducing, either by the judicious application of caustic, or other means, such a degree of inflammatory action over the site of the tumour, as might establish adhesion between the two folds (the parietal and intestinal) of the peritoneum, whereby the opening of the bowel might be effected without opening the serous cavity itself.

(*Alexander Monro.*)

AMADOU, see AGARIC.

AMAUROSIS, from ἀμαυρόω, to obscure. *gutta serena, cataracta nigra*, Lat.; *Schwarzer Staar*, Ger.; *amaurose*, Fr.; *gotta serena*, Ital.; *drop serene, blindness*, Eng.

The derivation of the term does not give an adequate idea of its present acceptation, which refers to affections of the nervous apparatus of vision only, and does not include the diseases of the cornea, lens, &c. which so frequently obscure the sight.

The same objection applies to the terms of more recent introduction, as—Dysopia, from δὺς, bad, difficult; and ὢψ, the eye (Cullen). Amblyopia, from ἀμβλὺς, obtuse or dull; and ὢψ, the eye (Savage). The terms considered synonymous in the older writers evidently refer to those forms of the disease which are not attended with any visible change of structure, but in which the pupil remains black and bright; as—Mydriasis, from μυδάω, to corrupt by moisture (Celsus); Gutta serena (Arabian); Suffusio nigra; Black cataract. The term Amaurosis is now employed to denote a diminution or loss of sight, from disturbance or change in some part of the nervous apparatus belonging to, or communicating with, the organ of vision.

It comprehends by far the most important of the ophthalmic affections, or those which most frequently involve loss of sight, which are least understood, and in which medical or surgical aid therefore avails least.

It is only since ophthalmic diseases have been investigated upon scientific principles, that we have begun properly to understand the great variety and importance of the amaurotic affections; and that their intricacies have been in some degree unravelled, so as to enable us to combat them with more certainty of success. Our knowledge of them is still however far from perfect, although their distinctions are becoming gradually more and more developed under the light of science. There can be no better proof of the prevalent ignorance respecting this class of diseases than the very frequent recommendation and adoption of one particular remedy in nearly all cases, and this even by men who profess and obtain credit for scientific inquiry.

The want of the external symptoms which characterize most of the ophthalmic diseases has perhaps induced and promoted such error in regard to this malady, and tended greatly to impede the scientific investigation of it. Some forms of amaurosis can only be detected and distinguished by a most patient inquiry, aided by experience and science; for the general symptoms of some different forms of the disease so closely approximate, that a superficial and hasty inquiry cannot suffice to form a correct diagnosis. Error in diagnosis unfortunately involves error in treatment, so as to occasion in many cases loss of sight, which, under correct management, might have been saved or restored.

Anatomical Division. — The nervous apparatus destined for visual purposes may be properly divided into three portions.

1. The retina, belonging to the globe itself.
2. The optic nerve, connecting the retina and the brain.
3. The cerebral portion, connected with the optic nerve, and forming part of the cerebral mass or brain.

Amaurosis may result from disturbance in part, parts, or the whole of this apparatus: thus, disease may affect separately the retina, the optic nerve, or the brain, or it may influence the optic nerve and retina together, or it may extend through the three parts at once. From the known principles of nervous power, it must be obvious that any disease affecting the cerebral portion of this nervous apparatus, or the optic nerve, must influence the extreme part of the nerve, or the retina, so that disease cannot exist in either of the former without producing a diminution or destruction of the functions of the latter.

Pathological Division.—In considering the pathology of this nervous apparatus, I believe that I cannot adopt a division which offers more practical utility than that suggested by the anatomical arrangement.

First, therefore, I shall treat of such diseases or injuries as affect the retina itself.

Secondly, of such as influence the orbital portion of the optic nerve.

Thirdly, of such as affect the cerebral portion of the nerve.

And lastly, of such as extend through the entire nervous apparatus.

Further, I purpose to separate the diseases in each division into two classes, viz.—those which are not attended with any appreciable change in structure, and are termed functional, and those which are attended with some change, and are called organic.

I consider as functional disease, that which is not accompanied by any change in structure which can be detected, and decided to be the result of a morbid action. Our knowledge, at present, only enables us to determine with any accuracy on such changes in the solid or firm textures of a part or organ; whilst, at the same time, there may exist various morbid conditions of the fluids, especially in respect of superabundance or deficiency, which the most experienced and diligent pathological inquirer cannot determine to be the result of a morbid action, nor distinguish from a change produced during the expiring vitality of the part.

The fluids are, strictly speaking, as much a part of the organization of an organ as the solids, and any morbid condition of them ought properly to be termed organic, as much as if it occurred in the firm texture; but the foregoing explanation of the term functional is that, I believe, most generally accepted, and that which I shall adopt, as facilitating description, and enabling me to give it with more practical utility.

Other distinctions or divisions of amaurosis are, however, recognized, arising from the degree, the extent, the duration, or the cause of the disease, which, though for the most part obvious, I shall nevertheless here point out, that I may be clearly understood in the subsequent use of the various terms.

Amaurosis—is perfect, complete, or entire, when the patient has lost perception of light.

It is imperfect, whilst any degree of vision exists, but the entire field is obscured.

It is incomplete, when a part, or parts, of the field is or are obscured, whilst with the other part or parts the patient enjoys vision.

It is temporary, or intermittent, when the vision is obscured or lost for short periods, but perfect or good in the intervals of the amaurotic attacks.

It is recent, or inveterate, according to the time of its duration.

Functional Amaurosis—(retina).

Definition.—Diminution or loss of vision from affection of the retina only, without any perceptible change in structure.

When the power of the retina is annihilated, the optic nerves, I believe, invariably shrink; and I have known little more than the neurolema to be found, in the extent of the optic nerve from the sclerotic to the optic commissure, in a case of functional amaurosis, originally confined to the retina, and of many years' duration. I have also seen the alteration extend beyond the commissure, but not so far as the quadrigeminal bodies.

Symptoms.—Gradual or sudden diminution or loss of vision, affecting the entire field generally; but now and then the field is only partially obscured, or insensible, whilst the other part remains perfect, or obscured in a minor degree.

Appearances.—Pupil usually large, round, and fixed, the motive power of the iris being destroyed; sometimes the pupil is irregular, the irregularity corresponding with the unequal sensibility of the retina; occasionally the iris is tremulous; and when the amaurosis is of imperfect character the iris moves sluggishly and perhaps irregularly.

Prognosis—depends upon the extent and duration of the mischief. If the disease be recent and imperfect the prognosis is favourable; if imperfect, but of long standing, it is much less so; if recent, or of long standing, but complete, very unfavourable.

Causes.—A very common cause of the imperfect disease is non-exercise of the organ, as in a person who squints and uses only one eye; or in a person short-sighted who uses a single glass and always to the same eye; or in those who use frequently a high magnifying power with the same eye, proving that the retina requires exercise to maintain its power as a muscle does.

Secondly,—excess of the ordinary stimulus (light), or its too great brilliancy, affects the healthy retina. Every one is familiar with the dark spectra which result from gazing at the sun for a moment or two, and can easily comprehend how the continued influence of bright light may occasion loss of sight. When the light is very brilliant and unexpected, the functions of the retina may be partially or completely destroyed in a moment; thus the artist who was engaged to take the panoramic view of London from St. Paul's cathedral for the Colosseum, was intently regarding some object by the aid of the camera lucida, when the transit of a dark cloud allowed the brilliant rays of the sun, concentrated by the instrument, to strike unexpectedly on the retina in the axis of vision; the effect was instantaneous palsy of that portion of the retina: it has not recovered its function, but that of the surrounding parts remains perfect. In the same way vivid lightning acts in producing amaurosis. I do not believe that the electric fluid has much if any influence in creating the disease, as I can hardly conceive it possible that such an effect only would result from so powerful an agent; though in a less destructive form I can imagine that electricity might annihilate nervous function.

An ordinary degree of light may so overexcite the retina when in a morbid condition as by degrees to destroy its function and occasion amaurosis; thus it is, in severe cases of scrofulous ophthalmia of long continuance, and attended at first with great intolerance of light (photophobia). I have known patients become amaurotic without any perceptible organic change, and in which I could not attribute the loss of vision to other causes than diminution or destruction of the power of the retina from long-continued over excitement, in the manner above-mentioned.

Thirdly,—Concussion from a shock which does not produce any perceptible organic lesion, is a frequent cause of partial or complete amaurosis. When the eye is unprepared for violence, a very slight blow will destroy the functions of the retina, but if the violence be expected, it will sustain a violent concussion without serious injury. The following is a most remarkable case of amaurosis of this kind: A young man was amusing himself by looking at some gentlemen who were shooting at pigeons from a trap, and was situated at a distance of about two hundred yards from the shooter. Immediately after a shot he was sensible of a slight blow on the outer part of one eye, which produced a slight stinging pain of momentary duration only; some confusion in vision induced him to examine the state of both eyes, and he found that he could not even perceive light with that which had been struck. On the following day he applied at the Infirmary, when I found the pupil dilated, the iris motionless, and a small ecchymose spot, about the size of a large pin's head, between the outer margin of the cornea and the external canthus; there was not any lesion of the conjunctiva or sclerotica, but merely a slight extravasation between the two; vision was completely destroyed, and he remained amaurotic, in spite of all treatment, which was carefully pursued for many weeks.

I have seen two cases of amaurosis from blows inflicted with the end of a whip lash: in one instance the sufferer was seated at the back of a stage-coach outside; and in the other the patient was driving in a gig, and passing a stage-coach, at the time he was struck. In neither case was there lesion of membrane, but slight ecchymosis and subsequent ophthalmia; one remained amaurotic, and the other recovered perfectly; but, in the latter case, the amaurosis was incomplete from the first. The more severe cases of this kind, attended with organic lesion, will be considered under the next head.

Fourthly,—Some of the narcotics appear to exert a particular influence on the functions of the retina, especially the belladonna, and those which possess somewhat similar medicinal properties. Many years since I applied the extract of belladonna very freely to allay the irritation and pain of surfaces exposed by malignant ulceration. In one case the disease existed in the cervix uteri and vagina; and, in a second case, it had attacked the rectum. The effect of the application was in both instances similar; it allayed greatly the local suffering, but produced a temporary amaurosis, with enormously dilated state of the pupils. I repeated the application after several days, when the amaurosis had disappeared, and with like result.

Several other poisons—animal, and mineral, as well as vegetable—affect vision; but at the same time disturb the functions of the stomach, or heart, or brain, &c.

Treatment.—When the amaurosis of imperfect character has arisen for want of due exercise of the organ, the obvious remedy is to give it the proper degree of exercise to restore the lost power; and this is in fact the only means of exciting the retina to its natural degree of activity. It is, I consider, best done gradually, to prevent the risk of any congestion likely to result from the constant use of a weak organ. Thus let the patient use the weak eye for half an hour on small objects, two or three times in a day, then for an hour, and so on, gradually increasing the period of exercise until the eye can be used for hours together without much inconvenience. Whilst the weak eye is in use, the perfect one must be closed or obscured. It requires much perseverance to effect a cure in most of these cases, even in such as are of recent origin. When the patient has lost the power of discerning large print, or when the affection has been of several years' duration, more especially if it be in an adult, I do not think that much good is likely to be effected by this plan; but when the patient retains the perception of large print, I believe that perfect vision may be restored. Little or no good can be effected by any other local or general means.

Amaurosis, resulting from the influence of too much or too brilliant a light on the retina itself, is generally of sudden occurrence, is most frequently perfect, and usually affects the entire field of vision, though, as in the case of the artist, it may be partial or affect only one portion of the retina. The cases of amaurosis of slow progress, usually supposed to result from the influence of too much light upon the retina, are produced from the congestive condition of the choroid, and the effect on the functions of the retina is secondary: this form will be considered with the organic retinal diseases.

The effect, then, of too brilliant light on the retina is very similar to the effect of concussion, not only in its immediate, but remote consequences, and requires a similar plan of treatment.

Before describing this, I have only to observe that the mischief likely to result from the effect of moderate light on the retina morbidly sensible, is easily avoided by excluding the light until the extreme sensibility has been subdued.

The immediate effect of a blow or concussion, as well as that of a too brilliant light upon the retina, is sudden, and may destroy either the function of a part or of the whole, or the function may be only impaired; the remote effect of either is inflammatory action. In these cases, when the function of a part or the whole is entirely and immediately lost, I believe that it is not to be ever restored, for I have seen very many such cases, and have adopted careful and continued treatment without any good effect. When the amaurosis is incomplete, the function of the retina in general gradually returns if the medical attendant prevents any destructive inflammatory action, and this is to be done by rest, local bleeding, quiet, moderate or abstemious diet, and purgatives; or when these are not effective, the use of mercury, or counter irritation by blisters over the eyebrow aids much. I think more good results from repeated blisters than from one kept open for some time. After all inflammation has been subdued, electricity or galvanism assists in expediting the recovery of the nervous power; strychnine might do the same, but I believe such cases would recover equally well, though not quite so rapidly, if left alone.

Disturbance of the functions of the retina, from the influence of narcotics, which does not create any other injurious effect, subsides on removing the cause, or withdrawing the use of the narcotic. When the amaurosis is accompanied with other morbid affections of stomach, head, &c. the case requires care and attention, and a mode of treatment, the explanation of which lies beyond my present limits.

There is a functional form of amaurosis resulting from congestion of the choroid coat of very common occurrence, and which, though temporary, often leads to permanent organic disease in this tunic, and produces perfect amaurosis: it will be described with chronic choroiditis.

ORGANIC AMAUROSIS—(RETINA).

Definition.—Diminution or loss of vision from alteration in structure, usually manifest on examination of the organ and affecting the retina.

A very large portion of the amaurotic cases come under this head, as it embraces all the morbid changes which take place in the retina or choroid singly, or in combination with disease of other tunics or humours of the globe, and which I shall treat of in the following order, giving however a minute description of those changes only, which I consider properly belonging to the subject of this paper.

1st, Inflammation of the retina, acute and chronic. 2d, Inflammation of the choroid, acute and chronic. 3rd, Inflammation of the globe generally. 4th, Lesions of the globe. 5th, Scrofulous and malignant disease of the retina.

The more scientific arrangement of the subjects would perhaps have been that which first offered explanation of the morbid changes affecting the retina itself immediately, and subsequently of those diseases which affect the retina secondarily; but the order which I have adopted will I think be of greater practical utility in more directly contrasting the two most important diseases, viz. retinitis and choroiditis.

INFLAMMATION OF THE RETINA—(ACUTE).

Synonyme—Retinitis.

Symptoms.—Sudden occurrence of severe pain; throbbing and darting, principally at first in the globe, but the darting extending to the brain, and coming on in paroxysms; great sense of fulness and tension of the globe, with excessive tenderness; much intolerance of light at first, with frequent flashes of vivid reddish, or orange-coloured light, or frequent scintillation, even when all daylight is excluded, and more especially at night, or when the patient assumes the recumbent posture; the suffering increased by sudden movement of the globe, which also produces flashings or sparks. At first sometimes a paucity of secretion, or an excess of it, which is hot or scalding.

In a short time from the commencement of the attack the vision becomes dull and cloudy, and the denseness of the cloud increases rapidly until the perception of the natural light is lost, whilst, however, the appearances of light clouds, flashes, and sparks continue. In the early stage of the disease objects appear occasionally tinged with red or deep orange colour, as now and then occurs on our summer or autumnal evenings. The pain soon extends from the globe to the orbit and its circumference, being particularly severe at the supraorbital notch; it is of remittent character: the attacks are most frequent in the evening, or early in the morning, often affecting the cranium and face on the affected side, producing severe hemicrania, with great tenderness, so that the patient cannot bear a nightcap, or covering on the part; the patient complains of the sensation of grit, or some foreign particle in the eye from the beginning of the attack.

When the disease has perfectly destroyed the vision, the suffering ceases suddenly or gradually.

Appearances.—The eyelids are usually closed, and often a little tumid and red; spasmodic action occurs in the orbicularis muscle on exposure to light, unless the vision be quite destroyed; I have, indeed, often observed the patients shrink from and complain of bright light, though they could not tell the direction of the rays, or their intensity. Lacrymation is abundant in most cases, and increased by exposure or examination of the eye. The conjunctiva exhibits several large and tortuous vessels, distended with purple-coloured blood, and passing from the direction of the attachments of the recti muscles towards the cornea, diminishing in size, but dividing and subdividing, and anastomosing, as they approach the corneal margin, beneath and in the spaces between the conjunctival vessels. Some of those of the sclerotica may be seen injected with blood of a lighter colour, but not so brilliant as that in the conjunctiva,—they are straight and small.

The iris is dull and discoloured, or looks dirty, the pupil is at first contracted, but soon becomes dilated and irregular, being oblong,—usually in a direction upwards and inwards; sometimes upwards, now and then horizontally elongated, and rarely downwards. The iris is motionless or nearly so. The blackness and brightness of the pupil is lost, and it has a dull and usually greenish aspect, with the appearance of an opake spot, as that seen in the onyx, but of a greenish hue, and which (as the spot in the onyx) varies its position according to the angle of incidence of the light; it has, perhaps, more resemblance to the reflection of the sun from a turbid and greenish stagnant pool. When this appearance is distinct, the term Glaucoma is applied to the disease, from γλαυκὸς, sea-green.

The feel of the globe is hard and inelastic.

In the last stage of the disease, the general redness diminishes in the conjunctiva and sclerotica, but the principal vessels of the former become larger, more tortuous, and of darker colour; the pupil becomes more dilated and fixed; the opacity of the humours increases, and complete *lenticular cataract* is formed, which has, however, nearly always some green tinge.

These changes are effected sometimes in forty-eight hours, and but seldom require more than four or five days for their completion.

General Symptoms.—Retinitis I believe always to be a consequence of some material derangement of the general or constitutional power, under which the balance of the circulation is easily disturbed; thus, in the history of these cases, it is usually found that the patient has been complaining, or has been observed, by those immediately about him, to have been unwell for some time previous to the burst of retinal inflammation. These general symptoms, however, become more manifest when the local disease is developed, and new symptoms present themselves as consequences of the retinitis.

Previously to the attack, there is generally lowness of spirits, despondency, loss of appetite, irregular state of bowels, disturbed sleep, or unusual heaviness and torpor, with headache; a loaded tongue, clammy mouth, and sometimes feeling of nausea; the extremities are cold, and there is a disinclination to mental or bodily exercise. The severity of the local disease rouses the system; the patient becomes restless and watchful; the surface and extremities are unusually hot and dry; the face flushed; the pulse is quick and sharp,—in some patients, hard and wiry, in others easily compressible; the tongue is more loaded, the mouth parched, and nausea, with much thirst, is experienced. The local and general symptoms are aggravated by the recumbent posture.

Prognosis is always unfavourable; in the majority of instances the disease makes such rapid progress, that the surgeon has not time to apply remedies to arrest its disorganizing effects; and in those cases in which he has opportunity to use his remedies, and even succeeds in arresting the disease so as to preserve a useful degree of vision, the patient is subject to relapse from such trivial causes that he seldom retains vision for more than a few months, but fresh attacks of inflammation complete the organic change, and destroy the functions of the retina.

The disease which I have described is rarely met with in persons under the middle period of life; is most frequent between the ages of forty-five and sixty, though often seen in persons of more advanced age. It is more common in females than in males, and is almost confined to persons having dark irides. I have, however, seen exceptions. It attacks sometimes one eye first, but more frequently both together, though not to the same extent; or it runs through its course with greater rapidity in one eye than in the other. When it appears only in one eye it will most probably appear in the other, unless the greatest caution be used. I have seen this disease most frequently in persons of sanguine temperament, with dark complexions and spare figures; or in those who have a large and soft frame, with indolent circulation, but much nervous irritability.

Causes.—The predisposing causes of this affection, are such as derange any of the more important functions, and tend to disturb or destroy the balance of the circulation, and of nervous power; but especially such as at the same time depress or exhaust general power.

Excess of mental labour, or mental anxiety alone, are sufficient to produce the effect; but they are particularly prone to do so when operating on a system in which disturbance has been already excited, as during a change in, or arrest of, uterine action; or from the arrest of long-standing morbid discharge from a natural secreting surface upon a sore; or, further, in consequence of the cessation of frequent and habitual hæmorrhage, either uterine, hæmorrhoidal, or nasal. Again, during suppressed gout. The exciting causes are over exertion of the organ, the influence of bright light, exposure to cold and damp; but I have often known the disease commence without being able to detect any particular cause as immediately inducing it. I have seen a few instances in which slight injury has called forth the morbid action.

The most rapidly destructive and distressing cases that I have witnessed have occurred during great mental anxiety and distress; as in the elderly female from loss of husband or child; and in the male from sudden loss of property and comfort, in consequence of imprudent speculations, or from the deceit of one previously esteemed and valued.

Treatment.—Although acute retinitis occasions such rapid disorganization, (by implicating other textures,) and annihilates the function of the organ in many cases; yet in some, the disease may be checked, and some useful degree of vision preserved for months, or perhaps years; and when only one eye is attacked, the fate of the second, I believe, much depends upon careful management.

The first object of treatment is to arrest the disorganizing action, and lessen or relieve suffering; the most powerful and proper agents to effect this are bleeding, mercury, and narcotics; but much judgment and care are necessary in their employment, or more evil than good will result, from the two former especially.

The force of general vascular action is, in these cases, usually below par, and general abstraction of blood is therefore not only unnecessary, but even likely to prove injurious; it should never be resorted to whilst the pulse is easily compressible,—only when it is hard and incompressible; and then very cautiously. Even local bleeding, by cupping-glass or leeches, must be cautiously employed when the circulation is depressed and feeble, or its effects may be injurious instead of beneficial. Unfortunately, the loss of blood, generally or locally, often mitigates suffering for a time, and therefore induces the patient to solicit the repetition of it; and, too often, the medical attendant, ignorant of its baneful tendency, follows up the deceptive plan of treatment. The disease cannot be arrested or cured by loss of blood; the only good, in my opinion, which can be effected by it is lessening tension of vessels, so as to retard the disorganizing process, and allow time for the operation of other remedies. I should only, therefore, abstract blood generally when the pulse is hard and incompressible, and then only in sufficient quantity to relieve the tension of the vessels; but, otherwise, I should prefer the use of leeches upon the palpebræ, as affording the means of emptying more readily the vessels of the affected part; and in particular cases, where the leech acts injuriously, I should apply the cupping-glass to the temple or behind the ear; to the former spot if no hemicrania existed,—to the latter if there were any cranial pain or tenderness.

Mercury I consider to be a more powerful and serviceable agent in this disease than bleeding, when properly employed; and equally dangerous as bleeding when used indiscriminately. It may be first given with some drastic purgative, followed by an alkaline saline aperient to carry off all the matter accumulated in the intestinal canal, and afterwards administered with a narcotic in a form, dose, and with a frequency adapted to the condition and ordinary character of the mucous membrane, and also to the power of the patient: at the same time general power must be maintained by a simple nutritious plain diet and stimulus, according to the previous habits of the patient; for those much addicted to stimulating drinks are rarely able to combat disease, if altogether deprived of that which they have become habituated to.

It is generally considered necessary in the treatment of this disease to follow up what is called the antiphlogistic plan of treatment in its strictest sense: and this, I am satisfied, is the most injudicious course that can be pursued; for where it may do good in one case, it will do mischief in at least a dozen.

The first object of treatment is, then, effected principally by local bleeding, by acting on the more important secretions, and by mild mercurial influence: but, further, local aids may be applied to allay suffering and retard the diseased action; first, by narcotic fomentations, ointments, and plasters; secondly, by counter-irritation: thus the eye may be exposed to the vapour of boiling water in which some narcotic has been mixed, or warm flannel or linen, sprinkled with laudanum or wine of opium, may be frequently applied to the surface of the lids. The use of much moisture, although it relieves at the time, occasions aggravation of suffering afterwards; and similar effects result from the employment of cold. Gentle friction, with a narcotic ointment over the supercilium and to the temple, I have found very serviceable in subduing local pain; and I have frequently combined the narcotic with the blue ointment, with excellent effect, in cases in which the internal use of mercury was objectionable, from irritable state of bowels. In other instances, when the ointments have failed to relieve, I have obtained the desired effect by covering the forehead and temple with a plaster made of soap cerate, opium, and belladonna. The application of blisters to the neck, or behind the ears, often proves very beneficial; I prefer the repetition of them, to the keeping up a discharge by stimulating means.

The second object of treatment is to subdue the local diseased action, and restore the balance of circulation and nervous power.

This is to be effected by a careful continuance of the local and general medicinal means described; aided by a regular, plain, and nutritious diet, moderate exercise, warm clothing, perfect rest of the organ, and, as far as possible, mental relaxation and quietude.

When once fairly checked, the inflammatory action rapidly subsides under the above treatment; and as the symptoms of severe character disappear, the various remedies appropriated to them may be laid aside; thus the local applications may be abandoned when the local pains are subdued, and the mercurial may be diminished, as the vascular turgescence lessens.

When all appearance of diseased action is gone, there is often much to do to place the patient in a state of safety, and unless this be done, the medical man ill performs his duty to his patient.

There is liability to relapse or to the occurrence of fresh inflammation from trivial causes, so long as the circulation is of feeble nature, and the balance of vascular action or nervous power unequal.

The patient should therefore be kept under surveillance, and made to continue a regular plan of diet and exercise, such as will tend to increase and maintain general power, and at the same time adopt a very mild alterative medical course to correct error in secretion, and improve the condition of the circulation. All mental excitement should be most carefully avoided.

Any return of uneasiness and appearance of congestion in the affected organ, should be immediately met by the application of a mustard plaster or a small blister, and a weak stimulating lotion of acetate or sulphate of zinc may be used once a day to promote contraction of the distended conjunctival vessels, as a few usually remain, after active disease has ceased.

If possible the patient should be placed in a pure air, till his health and strength are renovated.

INFLAMMATION OF THE RETINA—(CHRONIC).

Synonyme—Retinitis.

Symptoms.—This disease commences either with slight dimness of vision accompanied with occasional scintillations or flashings of light; or the appearance of flashings, &c., is the first indication of diseased action, and is quickly followed by a diminution of visual power. The entire field of vision appears dull or misty; and the patient seeks a bright light, by which the sight is somewhat improved. Often from the commencement a dull pain is experienced at the brow, corresponding particularly to the site of the supra-orbital notch; usually the pain is remittent, being severe only for short periods; or it is sometimes intermittent, though not with any regularity; it frequently extends to the forehead, temple, and cheek. These symptoms augment by degrees; the vision becomes more obscured, the pain more frequent and severe, as well as extended, and the luminous appearances occur in greater variety and number; there is, however, much difference in the amount of pain and in the degree of flashing, &c. in different cases. I have observed that they are usually proportioned to the progress of the disease, being trifling when it is slow, and more urgent as it is rapid. I have known the disease pass through all its stages to the destruction of vision without any pain, but never without some scintillations or luminous appearances. These appearances present almost endless variety in different patients; from a single small spark, to the most vivid and brilliant coruscations or flashings; sometimes there is a semblance of fire-works, sometimes bright circles of unequal brilliancy, fixed or in motion, and occasionally spreading out and vanishing, as the circles created by the falling of a stone on the surface of a smooth pool; at other times the figures are oblong or square. Whatever may be their figure they are seldom very troublesome in the early stage of the disease; but often continue even for years after the amaurosis is complete.

In the early stage of the disease the power of adapting the eye to near and distant objects is sometimes diminished or lost, so that an object seen with tolerable distinctness in one position, becomes indistinct or lost if its relative distance be changed. I do not, however, consider this to be the result of retinal affection, as I shall hereafter describe. More frequently objects appear distorted (*visus diffiguratus*) especially those which present much length or height with little breadth; they seem bent or broken.

The symptoms are aggravated by whatever disturbs the circulation suddenly, as a change from the erect to the recumbent posture, fright, or any sudden mental emotion; or whatever effects this change in the vascular system more slowly, and depresses power, as continued mental labour or anxiety, exposure to damp and cold, derangement of digestive organs, exhausting exercise; they are also augmented by too much exercise of the organ itself.

The symptoms are mitigated by whatever tranquillizes the circulation and promotes its power gradually and tends to maintain it in equal balance; thus vision improves, pain subsides, &c. from a few hours' quiet repose, and a similar effect results from a moderate nutritious meal.

Whilst power of vision remains, it is always improved by a bright sun-light; though the ordinary artificial light is of little or no assistance.

The sensation of some fine particle or particles of foreign matter being in the eye, is also a common symptom in chronic retinitis, and sometimes the globe feels full and tender.

Appearances.—The first deviation from the ordinary condition of the different structures of which the organ is composed, is to be perceived in the pupil, which loses its circular figure and becomes oblong (very slightly so at first), and is generally elongated upwards and inwards in a direction towards the trochlea of the superior oblique muscle, but the direction of the elongation varies as I have described in the acute disease; the alteration is upwards and inwards, in at least nineteen cases out of twenty; and in whatever direction it occurs, there is always a general dilation, but at first also very trivial, and the motions of the iris are rather sluggish. By degrees the pupil becomes more dilated, more irregular in figure, and the motions of the iris more difficult; the space of the pupil loses its blackness, and assumes a dirty grey or green appearance, which exhibits unequal density, there being usually a spot more opaque than the other parts, and which resembles the commencement of cataract, for which it is often mistaken: the distinction is however simple. The cataractous opacity is in the lens, and occupies its central part in ordinary cases, and maintains this relative position whatever may be the incidence of the light, or whatever may be the position in which the pupil is regarded. The opacity consequent upon chronic retinitis, (when in the degree I have described) always changes its position according to the incidence of the light, so that it appears central (as the cataractous opacity) when the light falls direct upon the pupil; but if the light falls from the nasal side of the cornea, the opacity of retinitis appears on the temporal side of the pupil; if the rays are incident from the temporal side, the opacity is seen in the nasal part of the pupil: it is always on the side remote from the origin of the incident rays, and can be made therefore to shift its position, by changing that of the patient, or by movement of the eye itself; it resembles the reflection of the sun or any other luminous body from a muddy pool. Besides its change of position from altered incidence of light, the opacity here described is distinguishable from its not appearing so near the surface as that which takes place in the lens.

As the disease advances, this turbidity of humour increases; the opaque spot becomes more dense, and assumes a more decided green tinge, from which the disease now obtains the name of Glaucoma. The iris now loses its brilliancy, and sometimes alters slightly in colour; and some distended tortuous vessels appear in the conjunctiva of a dark red or purple colour, and passing from the recti muscles to the cornea.

Lastly, the lens actually becomes opake and cataract exists, but almost invariably it has a greenish tinge : I have seen it of the deep green colour of the sea, and in a very few cases of a dirty yellow colour. This is in the last stage, when the pupil is extremely dilated and fixed. The distended or varicose vessels of the conjunctiva are numerous ; the globe is hard and inelastic, and appears more prominent than natural.

This disease, unchecked, usually proceeds through its different stages in the course of a few months, sometimes in only a few weeks ; but under careful management I have seen it retarded for years, so as to preserve some useful vision, but this can be accomplished only in very few cases.

The disturbance of the function of the retina is not at all in proportion to the visible organic change, for useful vision is generally lost before there is much change apparent in the vitreous body, or before the change is sufficient to account for the diminution of function in the retina.

The history of this disease affords a very beautiful illustration of the extension of morbid action by vascular connection.

First, disturbances evinced in the retina by flashings, sparks, &c., by diminution of vision, and further by the direction of pain in the acute cases, and the sympathetic pains in both forms.

Secondly, the vitreous body becomes turbid ; and, lastly, the lens loses its transparency, and cataract forms.

Thus, after morbid action has been fairly set up in the retina, as supplied by the primary divisions of the central artery, the vitreous body, as the next part supplied by the continuation of this arterial distribution, soon participates in the disease ; and subsequently the crystalline lens, organized by the extreme division of the same vessel, becomes affected, and undergoes some such morbid change as the retina and vitreous body have previously undergone.

The changes in the vitreous body and lens are apparent during the progress of the disease, and in a great measure prevent us from observing the condition of the retina. From examination of this structure after death, in persons who have suffered from glaucoma, it is stated by some, that no morbid change can be detected ; this I think probable, inasmuch as exceedingly slight change may take place, which our imperfect acquaintance with the healthy state of the membrane will not enable us to recognise ; and further, so rapid is the change in this part after death, that a few hours occasion a great difference in its appearance. I conceive that the examination should be made very shortly after death, and by a very experienced pathologist and anatomist, in order to detect any diseased condition.

General symptoms—consist in derangement of some important function, with an unequal balance of circulation and nervous power ; these are, however, causes rather than effects, and co-existent with the development of the disease.

Chronic retinitis, in the acute form, is a disease confined to persons advanced in life, is more frequent in females than in males, and attacks very rarely the eye with a light-coloured iris. It very seldom commences in both eyes simultaneously, though it seldom exists for many weeks or months in one eye, without the other becoming affected ; but I have seen it disorganize one eye, whilst the other remained sound.

Causes,—both predisposing and direct, are the same as in the acute form of disease, with the exception of violence, which however sometimes converts the slow or chronic affection into the acute ; and this indeed takes place from other causes, as cold, damp, over-exertion, &c.

The attacks thus excited are frequently not very violent, and are easily subdued, but they materially hasten the loss of function of the retina, and when once stirred up, are prone to reappear until the perception of light be lost.

In persons of gouty diathesis, who have experienced for some years several attacks annually of arthritic inflammation, but in whom such attacks are suddenly suppressed, and in those who have for years been subject to continued or periodical discharges or hæmorrhages which become unexpectedly arrested, the first stage of glaucomatous disease frequently occurs, without producing disorganizing effects ; and a return of the previous affection is sometimes followed very speedily by a disappearance or great diminution of the ocular disease ; so that the patient again enjoys useful or good vision.

Treatment.—The first endeavour should be to do away with the exciting cause, as over use or exposure of the organ, and then, if possible, to subdue the predisposing cause ; this latter, I regret to say, is too often beyond the reach of our limited science and art, being mental in so many instances ; but although we cannot subdue, we may mitigate the unfavourable state which promotes the progress of the local disease.

First, then, the patient should be taken from employment which requires much ocular or mental exertion, and be guarded from exposure to bright lights, or from the influence of sudden atmospheric changes ; and by degrees, perhaps, he may be induced to engage in some business or employment which may amuse, but not fatigue ; and serve to occupy the mind, sufficiently to exclude distressing thoughts.

Dietetic and medicinal means should be employed to correct error in any great or principal function, and at the same time to support strength, and equalize vascular and nervous power.

Persons subject to this disease but very rarely require depleting measures ; as it nearly always arises under a depressed and irregular condition of circulation. If there are symptoms sufficient to warrant the loss of blood generally, it should be abstracted with great caution and sparingly.

The general plan of treatment that I have described as necessary for subduing the acute form of the disease, is that best adapted to arrest, and perhaps, in a degree, subdue the chronic affection.

The local symptoms of fulness or pain are best remedied by counter-irritation, viz.: mustard plasters, not to vesicate; blisters repeated; or tartar-emetic ointment applied as a small plaster: these all act most beneficially when applied over the expansion of the supra-orbital vessels and nerves. In cases where there is much ocular congestion or cerebral fulness with flushing and heat of head, a few leeches may be applied to the palpebræ, or a single cupping-glass behind the ear; but blood must not be removed to such an extent as to affect the general power, or it will inevitably prove injurious.

The observations previously made on clothing and exercise, in the treatment of the acute disease, apply equally in that of the chronic.

There are two other diseases which affect the retina and by occasioning organic change produce amaurosis.

One was, I believe, first noticed and described by Beer, and named by him the cat's eye, from its being characterized by a brilliant metallic lustre, like that observable in the eyes of the cat and other animals of the same kind, in particular positions, or under certain modifications of light.

This disease is extremely rare; the few examples that I have seen of it, have been in males. The first case which came under my observation was in a boy about ten years of age, of healthy aspect and make: his parents stated that he was blind, that he had been so for some time, and that the loss of vision had been gradual. He had a somewhat vacant countenance, which was the only circumstance that indicated his loss of vision; for when I examined his eyes by the aid of a strong light, I could not detect any change in texture or function which could account for amaurosis; the humours appeared perfectly clear, the iris healthy, most active in its motions, and obedient to the influence of light. From these circumstances I suspected that the boy was feigning blindness, but kept my suspicion to myself, and ordered some simple medicine; he was brought two or three times to me before I detected the nature of the complaint, and this I did accidentally. He was standing a few feet from me, among some other patients, in a situation shaded from the bright light admitted by the window, when I observed a brilliant metallic reflection from the pupils of his eyes, such as would take place from a cat's eyes similarly placed: upon his being brought into a clear bright light this appearance could no longer be discerned; but when he was again placed in a shaded part of the room, at a distance of a few feet from me, it became again evident. When the pupils were dilated by belladonna, scarcely any morbid appearance could be seen, so long as the eye was exposed to a clear bright light; but the metallic reflection was brilliant, and readily perceived in a moderate light at a short distance, whilst, on close inspection, it always disappeared.

The patient attended for several months at the infirmary, and mild alterative treatment was adopted but without any advantage, or any increase of morbid appearance.

In another case also, which I had an opportunity of watching for some months, no perceptible change took place; and in all the cases of this kind that I have seen, the amaurosis has been complete.

I am disposed to consider this disease as occurring in the choroid, or between it and the retina, from the close resemblance of the metallic reflection to that seen in the feline tribe, in which we know the appearance to result from the tapetum; and further, because I believe that a morbid change in the retina which could give rise to such an appearance, would be easily detected under a close inspection in a bright light, especially when the pupil is dilated.

As to the other disease, we are satisfied, by anatomical investigation, that it is seated in the retina. It presents at first either of two different appearances—sometimes a bright yellow colour pervades the entire pupil, and on close inspection (the pupil being dilated) a uniform opake yellow deposit can be easily discerned in the site of the retina; but in other cases, the yellow appearance in the pupil is partial, and when the pupil is dilated part of the surface of the retina exhibits opake yellow tubercles, whilst in other parts its usual dark and brilliant appearance is retained. The yellow deposit, whether uniform or tubercular, presents usually a few or numerous red vessels, carrying red particles of blood. When it is entire and uniform the patient is completely amaurotic, but when tubercular and partial, the portions of the retina not occupied by the deposit retain the usual degree of sensibility; this lasts, however, only for a short period, for the disease soon extends over the whole surface of the membrane.

Either appearance is usually regarded as the commencement of malignant fungoid disease; but I believe that such an opinion is erroneous, it being in many instances a merely scrofulous deposit: my principal reason for expressing this belief is, that I have known several of these cases to terminate in atrophy of the globe, under the most careful management.

As the treatment of this disease, however, is not adopted with a view to cure the amaurosis, which I believe to be inevitable, I cannot here enter into it.

This disease most frequently appears in infancy, very rarely in adult persons: it is distinguishable from the cat's eye, in being apparent in almost any degree of light.

In the eyes of old persons, the pupils have sometimes a greyish or silvery appearance, somewhat approaching the cat's eye; this results from a deficiency of pigment, which can be detected when the pupils are dilated, and which is attended with a diminution of the power of vision.

INFLAMMATION OF THE CHOROID—(ACUTE).

Synonyme—Choroiditis.

Symptoms.—Pain deep-seated, dull, throbbing, with occasional shooting, and sense of fulness or tension of the globe; vision disturbed, the field being obscured by grey or black spots (muscæ), or by a dark net-work or gauze, or by clouds, as of mist. Usually at first the disturbance is unequal, one part of the field being obscured more than another, and most frequently the obscurity is greatest at the inferior part; there is also some tenderness of the globe; often dull circumorbital pain of remittent character, and head-ache, or sense of weight at the forehead.

The symptoms increase rapidly, and vision is soon destroyed.

Appearances.—The eye appears partially red or inflamed, and the redness is dull and of a brick-dust colour; a close inspection shows that it results from many of the small straight vessels of the sclerotica being distended with red blood; they pass from the margin of the cornea towards the orbital margin, being most abundant near the cornea: the injection of these vessels is usually partial,—perhaps one-half of the portion of the sclerotica exposed may exhibit them, whilst the other part retains its ordinary character; or, if the whole visible surface be red, one part is more deep in colour than another; a few tortuous vessels of the conjunctiva, slightly distended with red blood, are also often visible, and may be easily traced as superjacent to those of the sclerotica, over which they may be made to move by pressing the membrane.

The iris soon becomes dull, the pupil contracted, and its margin slightly irregular; and by degrees this membrane grows discoloured, and a thickening, with more irregularity, occurs at its inner border, which becomes attached, by points, to the anterior capsule of the crystalline lens (synechia posterior). Lastly, the capsule of the lens becomes opake, or covered by a deposition of opake fibrin.

The sclerotic coat in very severe or protracted cases, now and then gives way near to the corneal circumference, and is protruded outwards (forming staphyloma scleroticæ); it is evidently thinned, and appears bluish or brown-coloured, from the subjacent varicose choroidal vessels or the pigment being partly apparent through it: the globe feels hard and tense.

This disease is confined very much to those who are of scrofulous diathesis and naturally of feeble power; it occurs in children, (I have seen it in infants,) and in adults below the middle period of life; very rarely indeed in elderly persons.

Causes.—Over-exertion of the eyes, or exposure to bright light, or to cold and damp. It rarely commences in the acute form, without some warning of congestive, or subacute character, which sometimes occur weeks or months before the acute disease bursts forth.

Prognosis—is favourable, if the retina be sensible of the influence of light, and there be no organic change affecting the capsule of the lens, or the sclerotic; and even when the capsule of the lens has become opake, without alteration in the sclerotic, vision may often be restored by medical and surgical means combined. Much depends also upon the duration of the affection: the prospect of recovery diminishing in proportion to the lengthened continuance of the disease and its effects.

Treatment.—The acute form is easily checked by local abstraction of blood by leeches or cupping, and by acting rather freely upon the secretions; but these remedies should be carefully adapted to the age and strength of the patient. I cannot, however, satisfactorily enter into the full consideration or explanation of treatment, without a description of the chronic form of the disease, which I shall therefore previously give.

INFLAMMATION OF THE CHOROID—(CHRONIC).

Synonyme—Choroiditis.

Symptoms.—More or less functional disturbance usually precedes the inflammatory action of subacute kind in the choroid tunic; and sometimes this disturbance continues for months or years without inflammatory action supervening. The great variations in the degree of disturbance, and the occasional or frequent entire subsidence of the symptoms, evince the functional character of the disorder. The most common derangement of this kind consists in the appearance of one or two or numerous grey or black spots or figures in the field of vision (muscæ), which present endless varieties, in figure, size and number, and occupy different positions in the field; most frequently they seem to move (volitantes,) especially on any sudden motion of the eye; thus, if the eye be suddenly directed upwards, and fixed for a short time in that direction, the spot or spots appear to ascend, and then gradually to descend, as if falling. Sometimes the muscæ are fixed, and occupy always the same relative position in the field of vision. On their first appearance, these muscæ are faint and evanescent, and of small size and number,—but by degrees, they increase in density, in size, and in number, and the forms vary and extend; they also become apparent for longer periods, until at last some become permanent. They are most readily discerned on a light and bright ground, or when the patient looks at white paper, a white wall, a light cloud, &c.; but they are not visible if the eye be directed to a black or very dark ground; as to a black paling, a black or dark dress, &c. On making an effort to fix them on a light ground, they sometimes enlarge, or fresh ones appear; but the previous state is resumed as soon as the effort ceases. I often regret that I have not preserved the numerous diagrams of these appearances which have been brought to me at different times by patients. They would have formed a curious collection; and demonstrated the infinite varieties of figure assumed by these ophthalmic muscæ.

Again, the function of the retina is very often disturbed in the following manner:—After the eyes have been engaged for some time on minute objects, the patient experiences a degree of confusion,—the objects becoming partly or wholly obscured by a network, or mist; but, after resting the eyes for a few moments, and rubbing or pressing them slightly, the vision again becomes distinct; this occurs again and again; the disturbance is excited more readily and more rapidly the more the vision is exerted, and a longer period of rest is required for the subsidence of the effect.

After some time any attempt to view minute objects reinduces the obscurity, and, eventually, the vision remains cloudy or dull, as if a piece of gauze, or a thick veil intervened between the eye and the objects regarded. This disturbance is frequently preceded or accompanied by muscæ, and is usually attended by a sense of fulness in the organs, and a weight or uneasiness about the forehead.

Whilst the sight remains good for all ordinary purposes, requiring but little exertion of the eyes, the term *impaired vision* is employed to denote this affection, at the London Ophthalmic Hospital, to distinguish it from the condition of constant imperfection in the more confirmed amaurotic disease.

Usually some degree or form of the functional disturbances which I have described precedes organic change in the choroid, although sometimes to a very trivial extent.

The commencement of organic change is indicated by some of the above-described symptoms becoming permanent,—as permanent and fixed muscæ, or a continual appearance of network or cloud which obscures vision. This network or cloud does not, however, always occupy the entire field of vision, but is often spread over only a small portion or portions of the space. Most frequently it is as a piece of gauze,—less frequently as a cloud or mist; and some few patients have described the imperfection to me, as if produced from an irregular spot or spots, made by smearing the object regarded with Indian ink or sepia.

Whenever these spots are of such magnitude as to occupy an eighth, or tenth, or more of the field of vision, the entire field is usually somewhat obscure, or soon becomes so.

Any of the above-described symptoms may exist for weeks, months, or years, with little augmentation; though, in most instances, a gradual increase takes place; but frequently a sudden acute attack supervenes, and the vision is perfectly obscured in a few minutes.

The symptoms are aggravated by sudden emotion, anxiety, bad condition of stomach, or whatever tends to disturb the circulation.

Appearances.—When the simple functional derangement exists in the form of muscæ volitantes, or in that of impaired vision, there is rarely any marked change in the characters of the different textures of the eye or eyes; under the last-named affection the pupil is sometimes unusually contracted, and the iris inactive; but as soon as the vision is permanently affected by a network or web, the pupil becomes sometimes rather dilated, but subsequently again contracts, when inflammatory action is set up.

When organic change has commenced, the iris becomes dull, altered in colour,—its pupillary margin thick, irregular, and partially adherent to the anterior capsule of the lens, whilst a few large and tortuous vessels appear in the conjunctiva. When the disease has been very slow in progress, the vessels of the sclerotic do not appear injected with red blood even when the amaurosis is complete,—but most frequently its vessels become apparent, close upon the margin of the cornea, occupying a part or the entire of its circumference; they are of a dirty brick-dust colour.

Eventually, the changes which I have described as consequent upon the acute disease, take place, and capsular cataract, with synechia, or staphyloma scleroticæ may exist. Before the sclerotic coat gives way, it has a bluish appearance, and the globe feels hard and inelastic.

Occasionally the disease extends to the deeper seated tunic and humours, absorption takes place, and the globe becomes soft and flaccid.

Within a few months just subsequent to the universally-lamented death of Her Royal Highness the Princess Charlotte, I had ample opportunity of witnessing and tracing the effects of choroidal congestion and inflammation.

At the period above-mentioned, all persons were anxious to evince their feelings of sorrow and respect, by assuming as early as possible the conventional garb of grief; and consequently, an unusual quantity of work devolved on all those engaged in dress-making.

It would answer no good purpose to detail here the excessive cruelty which mercenary considerations induced many of the dress-makers, &c., to exercise over their dependents and apprentices, and which led to imperfection of vision in many, and entire loss of the blessed function of sight in several of those poor and tender beings.

Of the great number of patients who came under my observation at the Eye Infirmary, and elsewhere, in consequence of disturbance or loss of vision from the cause above mentioned, the majority were affected with muscæ in various degrees, or impaired vision; in others, symptoms of incipient organic change were manifest,—some had marked inflammation in the choroid and iris, with great obscurity of sight, and in a few the eyes were destroyed as visual organs, by disorganization of the more delicate tunics and humours.

The more robust suffered least, the most delicate became amaurotic, and generally the amount of mischief was in proportion to the relaxation and debility of the system.

The commencement, progress, and termination of choroidal disease was thus most clearly placed before me in its several stages, from the condition of simple and partial congestion, or simple functional disturbance, to the development of inflammation in the choroid and iris; its extension to other important textures, and its termination in a widely-spread disorganization.

Predisposing Causes—exist in those of decided strumous diathesis, or of weak and delicate frame, with feeble circulation, either congenital, or induced by mode of living, occupation, previous disease, inordinate discharges, secretions, or hæmorrhages, &c.

Direct Cause.—The disease is usually excited by exposure to cold or damp, bright light, or inordinate use of the organ; it is sometimes difficult to assign any particular circumstance as the immediate cause, for I have seen the inflammatory and disorganizing stages of the disease in infants, before the period at which they generally acquire distinct perception of surrounding visible objects.

The functional derangements are often caused by gastric, hepatic, or intestinal disturbance, so much so that few who participate in the luxuries of the table escape them altogether, but have now and then the volitant muscæ. The condition of impaired vision is also sometimes dependent upon and produced by the same causes, but especially by excessive use of the eyes on minute objects; and is, therefore, of more frequent occurrence among milliners, tailors, shoe-makers, watch-makers, jewellers, &c.

Choroiditis, according to my experience, is much more frequent in females than in males; it affects most generally those of fair complexion with blue irides, and seldom appears after the middle period of life.

Treatment.—Under this head I must consider separately the functional and organic conditions of the disease, and, further, make some subdivisions, as follow:—

1. Functional disturbances:
    a. Muscæ.
    b. Impaired vision.

2. Organic disturbances:
    a. Affecting choroid and iris.
    b. Extending to capsule of lens.
    c. Distending the sclerotic.
    d. Affecting the deep tunic and humours, and producing atrophy of the organ.

The muscæ which result from gastric, hepatic, or intestinal disturbance, are the most common, and are usually grey or dark; they appear generally as irregular lines, or small spots, and are volitant and evanescent. In persons naturally robust and healthy, they appear after excessive indulgence in food or drink, and especially when the quality of either be indifferent; loss of appetite, dryness of mouth, nausea, headach, chilliness, and restlessness, are the common attendants. Persons habitually dyspeptic are often affected by similar kinds of muscæ, which vary in number, form, size, figure, &c., and now and then disappear. In either case, they result from the irregular state of the circulation, sympathetic with, and dependent upon, digestive derangement. The principle of treatment in such cases is obvious, viz., to correct the error in the functions of the digestive organs;—and I must be satisfied with naming the principle, without describing the means, as I neither have space nor inclination to enter into a subject of such vast extent, and so complex, as the treatment of dyspepsia. I must, however, observe, that in cases of muscæ of long standing, counter-irritation, by small blisters, or mustard plasters, to the temple or forehead, is sometimes very serviceable, in addition to the general treatment.

The network, or gauze, which appears and obscures vision, partially or totally, from over exertion of the organs, and constitutes the condition termed impaired vision, results from a partial or complete congestion of the choroidal vessels, and may occur in two opposite states of the circulation:—1st, and most frequently, when the action of the heart and arteries is below par or feeble; 2dly, when the vessels are fully distended, and the action unduly violent. The general aspect of the patient, the condition of the pulse, and the influence of food and position on the vision, are sufficient to indicate the asthenic or sthenic forms of the disease. When the former exists, the patient is pale, and looks wearied; the pulse is quick and feeble, being easily compressed; the vision usually improves after meals, and is relieved by the recumbent posture. In the latter, the patient is florid and flushed; the pulse is full, quick, and hard, and the local disease is aggravated by food, or by the recumbent posture. The asthenic disease is produced by much exertion of the eyes; the sthenic arises from trivial use, or is sometimes induced merely by straining or stooping.

In treating the impaired vision, which coexists with deficient power, attention to the general health is as essential to the production of any permanent benefit, as attention to the affected organs; thus whilst the organs are rested and kept from the excitement of work and bright light, counter-irritation is resorted to in a moderate degree; the secretions should be at the same time properly regulated; and the power improved by diet, and mild tonic remedies. For example, the patient should refrain from using the eyes, except for ordinary purposes, as in dressing, walking, eating, &c.; and if there has been uneasiness or sense of fulness in the eyes or forehead, blisters should be applied to the temples or to the forehead, but not kept open. Small doses of mercurials, with mild aperients, and diaphoretics, or narcotics, are necessary, according to the state of the digestive organs, the skin, or of the nervous susceptibility: and further, some mild tonic, as sarsaparilla, cusparia, cascarilla, may be used to promote appetite, and improve digestion: in delicate and young persons, steel is often of great service. The diet should be nutritious, but not stimulating; and exercise should be taken in moderation, but never so as to create fatigue.

The adoption of this plan is easy in all cases, except in respect to one circumstance, which is of great importance; viz.—the rest of the eyes. The disease is extremely common in those who have to obtain their livelihood, and support a family also, by work which in many instances, cannot be followed without much exertion of vision, but which cannot be altogether given up. I have generally found that such cases can be cured by regulating the labour of the eyes, and steadily persevering in the other means which I have detailed. By regulating the labour of the eyes, I mean dividing the work so as to prevent congestion, and giving intervals of rest for the recovery of tone in the organs to carry them through a fresh period of employment. Thus, supposing a patient can work an hour without the vision being impaired, but not longer, he should then be directed to work only for half an hour at a time, and to allow intervals of rest to the eyes, of a quarter of an hour; he can thus work four-fifths of his usual time, while his cure proceeds at the same time. The period to be employed at work, and the intervals of rest, must be regulated by the character of the affection. As a principle, however, it may be laid down, that the period allowed for employment should always be short of that required to create disturbance of vision; but the time designed for resting the eyes should never be less than a quarter of an hour.

I have succeeded in curing very many cases by this plan of treatment.

Supposing that the impaired vision occurs within half an hour after the eyes have been employed at work, it is best for the patient to lay aside his business for a week or two until the affection be mitigated; for he could hardly adopt the plan above recommended in less urgent cases, as the periods allowed for work would be too short for him to gain much advantage by his labour. In all cases, use of the eyes with the aid of artificial light should be as much as possible avoided.

The impaired vision caused by a condition of plethora or fulness of the vascular system, is readily cured by lessening vascular tension; by the moderate abstraction of blood, a diminution of diet, and attention to the principal secretions, with rest of the organs for a few days.

The fixed and permanent muscæ, I consider to be the result of the most trivial organic change in the choroid; and usually produced by a partial morbid enlargement, or varicosity of the choroidal vessel or vessels; whilst the evanescent muscæ are, I believe, created by pressure on the retina, from a partially congested vessel or vessels. When the fixed muscæ occur, with a general obscurity of vision, and evidence of inflammation of the choroid, they may have been produced by a morbid deposit in or on the choroid which presses the retina. I have come to this conclusion, in consequence of finding that the fixed muscæ in a field of vision otherwise clear are rarely to be removed; whilst those which exist with a general disturbance of function of the retina, frequently disappear with the inflammatory action of the choroid.

The appearance of one or two dark and fixed muscæ, without any further disturbance of vision, is common, and most frequently of sudden origin; but occasionally it is preceded by the evanescent muscæ. Unless there appears a tendency to an increase in size or number of the muscæ, I now feel little inclination to adopt any particular treatment for them, but caution the patient against the exciting causes of choroid congestion. I have, formerly, in numerous instances, treated such cases by active, and by alterative and continued means, with a view to their cure, but with so little good result, that I am now content to arrest the progress of the affection; and I find that the patient soon becomes accustomed to the muscæ, which do not wholly impede his vision. Several persons whom I am in the habit of meeting often, have these fixed muscæ, but have become so accustomed to them, that they are scarcely conscious of their existence unless asked about them.

To check the increase of the fixed muscæ, the treatment which has been described as successful in removing the volitant and evanescent muscæ, is in principle that which I adopt.

Inflammation of the choroid, as a primary disease, either in acute or chronic form, is not very common, and is, I believe, but indifferently understood, being frequently confounded with iritis, of which it may be the cause; for the very intimate vascular connexion between the seats of those diseases hardly admits of the existence of inflammation in one without the other being rapidly affected.

Choroiditis, therefore, produces iritis; and iritis produces choroiditis.

It is a matter of considerable importance to form a correct diagnosis, since the success of treatment in these diseases (as in most others) mainly depends upon it. I shall, therefore, point out the marked differences in the early symptoms, and I trust render the diagnosis simple.

In choroiditis, disturbance of vision precedes any alteration in the iris, or sclerotica; and when the iris becomes sensibly affected, the change in its colour, and loss of brilliancy, is not in proportion to the loss of power in the retina; and the amaurosis is often nearly complete before any increased action is apparent in the sclerotica.

In iritis, change in colour of the iris, loss of brilliancy, and even tubercular deposit of fibrin often precedes the diminution or loss of vision; and also an extensive injection of the vessels of the sclerotica around the margin of the cornea, and a considerable degree of conjunctivitis may exist with iritis, and yet the vision be little disturbed.

It must be remembered, however, that iritis cannot well exist for many days without the disease extending to the choroid; and as soon as the choroid becomes affected, vision is disturbed and soon destroyed. If disturbance of vision precedes inflammatory symptoms in the iris, the disease has commenced in the choroid; but when change in the iris takes place before amaurotic symptoms occur, the iritis is primary, and the choroiditis secondary.

Before the iris participates in the disease originating in the choroid, the symptoms I have described must, I conceive, render the diagnosis easy; but as soon as the iris, sclerotica, &c. become implicated, the origin of the disease can only be detected by a careful examination into the history of the case.

The commencement of organic affection of the choroid, although unattended by any marked symptoms of inflammatory action, demands serious attention and careful management; the patient being otherwise constantly liable to a sudden burst of inflammation and its consequences.

The existence, then, of a network or gauze, or the appearance of large dark spots in the field of vision, unaccompanied by pain or uneasiness, or by any other evidence of increased action in the vessels of the conjunctiva or sclerotica, should meet with prompt attention and careful treatment, by which the integrity of the organ may be, in most instances, restored, and, at all events, useful vision preserved.

The organ should be perfectly rested, and kept from exposure to bright light; counter-irritation, by means of blisters or tartar emetic ointment, should be created upon the forehead or temple; the diet should be adapted to the power of the patient, but he should avoid stimulating food or drink (beyond that which habit may have rendered necessary), and such matter as is not easy of digestion, or is incompatible with the medicine employed.

Medicinal treatment should first be directed to correct errors in secretion, and restore the disordered functions,—the accomplishment of which is frequently sufficient to subdue the ocular disease; but should the vision continue disturbed, the alterative mercurial course should be adopted, and the local remedies continued. It is very rarely necessary to produce mercurial action in the system.

When the patient experiences a sense of fulness in the eye, or pain or uneasiness about the forehead or temple, in addition to the disturbance of vision, abstraction of some blood, by cupping-glass or leeches, may be required, and a more simple and abstemious plan of diet should be adopted so long as such symptoms exist; and under the continuance of this symptom, loss of blood may be again resorted to with advantage.

Blood should always be taken away in moderation, and only in sufficient quantity to relieve congestion, but not to affect the general circulation.

When decided inflammatory action occurs, the treatment must be active, in proportion to the symptoms and the powers of the patient. I have observed that the disease attacks principally those of naturally feeble constitution; therefore, if depletion be requisite in the commencement of treatment, the patient should be most carefully watched during its continuance, so that it may not be carried beyond the extent required to check the acute symptoms, nor produce unnecessary exhaustion. In many cases, when the disease is apparently acute, but the power feeble, the loss of blood aggravates, rather than benefits, the affection; this I have observed most frequently in young and delicate females. I have known the continuance of depletory treatment prove most injurious in augmenting the morbid action and hastening the disorganizing process.

Unfortunately, as relief frequently follows the local abstraction of blood, the patient in every fresh attack or relapse is desirous of resorting to the same treatment again, and the medical attendant, unacquainted with its injurious effects, readily adopts it: the relief is however of short duration; another burst of acute symptoms in a few days occurs—the same remedies are again resorted to, with similar effect, but the patient is further reduced in power, and the local disease has made some progress in disorganization; under continuance of this treatment the patient suffers from repeated attacks of the acute kind, each of which produces an increase in the amaurosis, and eventually vision is completely destroyed, while, at the same time, the general health is materially deranged, if not permanently injured.

I have seen several very distressing cases of permanent amaurosis resulting from such treatment; and I have also known many instances in which the disease has been arrested and vision preserved, by raising and maintaining the general power, and pursuing the medical treatment which I have recommended, after many weeks of depletion had failed to produce the desired effect.

I much wish that I had space to illustrate these observations by cases.

The chronic form of the disease often proceeds in such an insidious manner that amaurosis may be produced in one eye without the patient being conscious of anything more than the muscæ or spots which occur in the early part of the affection; this, however, happens very rarely; but frequently patients allow the disease to proceed to the extent of destruction of useful vision in one eye before they seek relief, in consequence of not suffering from pain. A similar insidious form of the disease may also go on, after the acute stage has been arrested, but when the morbid action has not as yet been perfectly subdued.

Before the amaurosis becomes perfect, the greater number of these cases can be remedied or much benefited by a steady perseverance in the alterative course, with attention to diet, to the condition of the secretions, and rest of the organ; now and then it is necessary to produce slight mercurial action, and maintain it for a short time.

These remarks are suited not only to those cases in which the pupil remains clear, but even to those in which the capsule of the lens has become opake, or covered by an opake deposit, and adheres to the pupillary margin of the iris, supposing that perception of light remains, and the globe retains its usual firmness, elasticity, and figure.

I believe that many of the last mentioned cases may be remedied by the union of medical treatment with operation, which would be lost by operative proceeding alone; the eye being much less disposed to inflammation after the medical course, whereas without it the operation will generally excite a fresh morbid action which will defeat its intention.

When the disease has produced a complete state of amaurosis, so that the perception of light is destroyed, the case is not entirely hopeless, unless the globe be hard, and the sclerotic has in part given way (staphyloma scleroticæ), or when, on the contrary, it has become soft and somewhat diminished in size; for when the affection is of very long continuance, the retina and vitreous body become sometimes implicated in the morbid action, and partial atrophy ensues. If, in fact, the globe possesses its natural firmness and elasticity, and the pupil be clear, I consider it worth while to give a fair trial to mercurial treatment, provided that the age and power of the patient admit of its adoption without risk. The treatment required is severe, but attended with much less risk than would be supposed, when carefully conducted. It consists in establishing a full and free mercurial action, and sustaining it for several weeks or months; at the same time, however, power must be maintained by good nutritious diet and a moderate quantity of stimulus. I consider that the safety of the treatment and its efficacy depend very greatly upon the support of the general power, for whilst this is properly sustained, I believe that the remedy cannot produce any general injurious effect, though its operation upon the local disease may proceed most beneficially. Unless the general power be maintained, the effects of the mercurial action on the system are extremely distressing and injurious; and it can rarely be continued long enough to remedy the amaurosis.

These observations result from great practical experience, not only in ophthalmic disease, but in other surgical affections, in which the continued and full use of mercury is of the greatest use in arresting and subduing diseased action.

The plan of treatment should be as follows: Confine the patient to his house or room, and ascertain if the principal functions are properly performed, and if not, let any error be corrected before the mercurial course be commenced. When the patient is in a fit condition, begin with small doses of one of the mild preparations of mercury, as the hydrarg. c. cretâ, or the oxide of mercury; and allow a form of diet equal to that which the patient has been generally accustomed to, but forbid the use of vegetable acids, greens, uncooked vegetables, or such articles of food as may be likely to interfere with the operation of the mercury. Watch the condition of the secretions, and suspend the use of the medicine under any attack of diarrhœa, or disturbance of stomach or bowels; and do not resume its exhibition until the disturbance be corrected, either by aperients, in case of irritating secretion, or aromatics and absorbents when there is only inordinate secretion. The mercurial preparations should be varied and combined with narcotics, to prevent, if possible, irritation of the digestive organs or alimentary canal; and if this cannot be avoided, the internal use of the remedy must be abandoned, and the external employment of it by friction resorted to.

As the operation of the mercury becomes manifest on the system, by a spongy and tender state of the gums, it often happens that the patient becomes depressed and irritable, and requires an improvement in diet, or a little more stimulus, to keep up his power; and occasionally I have given some bitter and ammonia with good effect. The mercury should never be pushed during general depression or irritability; but, if possible, the action obtained should be maintained, and as soon as general circumstances will permit, the action of the medicine should be gradually increased, until a full effect be produced, and a free discharge of saliva occurs.

When the tenderness of the mouth prevents the patient from taking solid food, nutriment should be frequently given in a soft or fluid state; milk, eggs, good plain soups, jelly, panada, &c., will afford ample support; the extreme tenderness of the mouth may be much relieved by a gargle of alum, or of chloride of soda, or by sipping some cool mucilaginous fluid.

Although in most instances some improvement takes place in the case, during the development of the mercurial action, yet occasionally, no perceptible change occurs until the full effect of the medicine has been kept up for some time. I have known three weeks elapse from the commencement of a full state of salivation before any marked beneficial change in the amaurosis has been perceived. The treatment should not, therefore, be abandoned under a month's trial.

Cases of complete amaurosis, from choroiditis, are very rare, without such evidence of disorganization as would forbid even mild, much more severe treatment; I have, however, seen a few cases in which much benefit has been obtained by the plan of treatment that I have detailed, and although it has failed in some instances, the success of it has been such as to warrant its recommendation.

One of the first cases of this kind that came under my care, was in a powerful man about thirty-eight years of age, from the north of Ireland, who was sent to me by my late excellent friend, Dr. Babington; he had been amaurotic for seven years, and had lost the perception of light; but the globes possessed their natural firmness and elasticity; the pupils were clear but irregular, from many points of adhesion between the pupillary margin of the iris, and the anterior capsule of the lens; the irides were discoloured and dull, and he had the vacant aspect of a blind person. I admitted him into the infirmary (then in Charter-house Square), and put him under mercurial treatment, with a nutritious diet; as soon as the mouth became tender, a considerable degree of sclerotitis occurred, with pain and tenderness of the eyeballs; the plan was, however, steadily continued, and some belladonna was applied night and morning to each eyebrow; he soon became sensible of light, and gradually acquired the power of discerning surrounding objects, and at the same time the adhesions between the iris and the capsule of the lens began to give way, and the pupils to reassume their natural figures. by degrees the vision improved, all appearance of inflammatory action subsided, the pupils became nearly regular, and the irides brilliant; the full mercurial action was kept up for above sixteen weeks, when the amaurosis was completely subdued, and his vision perfect. For sixteen weeks he discharged about a pint and a half of saliva daily; but in spite of the severe treatment, he came out of the course improved in appearance, and evidently increased in bulk.

In one other case, I have known a perfect recovery from complete amaurosis under similar treatment; and in other instances a useful degree of vision has been obtained.

When the patient retains the perception of light, or of large objects, the prospect of recovery from the treatment recommended is much greater than in the cases of complete amaurosis.

The existence of capsular cataract, or opake deposit, on the capsule of the lens, renders the recovery by medical treatment alone very improbable; but, as I have observed, many of these cases may be greatly benefited by medical and surgical treatment combined.

In those instances in which a perception of light remains, although the pupil be obscured (but without other evidence of disorganization), I should recommend a mercurial course, proportioned to the power of the patient; after which, by careful operative proceeding, vision may be frequently restored to a useful though very rarely to a perfect extent. The limits of the present paper forbid my entering into the description of the appropriate operations.

The existence of staphyloma scleroticæ with amaurosis, as a consequence of choroiditis, renders the case nearly hopeless; but whilst any useful vision remains (which is possible), it may be perhaps preserved by the treatment already described. A softened and shrunken globe indicates extension of the disease from the choroid and iris to the retina and vitreous body, and such a case is past relief from medical or surgical skill.

INFLAMMATION OF THE GLOBE.

Inflammatory action occasionally takes place simultaneously in all the tunics, and in the principal humours or their membranes.

Symptoms.—Severe and continued pain in the eyeball and about the orbit, with frequent dartings which extend to the brain, and produce excruciating suffering. A sense of tension of the globe, as if it would burst, with excessive tenderness, and constant scintillations or flashings of light; a sense of difficulty in moving the eye, and an aggravation of pain by attempt to move it; secretion at first lessened, and sometimes afterwards profuse; after a short time, swelling and tension of the palpebræ takes place, and the patient feels increase of suffering when recumbent.

Appearances.—Palpebræ swollen and red; globe appears projecting; the vessels of the conjunctiva and sclerotic distended with red blood, so as to present a dark red surface; cornea slightly hazy; iris dull and discoloured; pupil dilated and irregular or oblong; motions of iris destroyed; pupil of a muddy and generally dirty green hue.

This disease occurs at the same period of life, and under the same circumstances as the acute form of glaucoma, of which I consider it to be an aggravated and extended form.

The destruction of vision by it is so rapid and complete, that medical and surgical skill avails little in preventing amaurosis; but the suffering may be mitigated, and the inflammatory action subdued, by the same plan of treatment that I have described as necessary in acute glaucoma. The disease is protracted under the use of such remedies as tend materially to lessen general power.

LESIONS OF THE RETINA.

Such accidents affecting the retina alone, are, I believe, extremely rare, as some of the other textures almost invariably suffer at the same time.

I have already pointed out how amaurosis occurs, from very trivial violence which does not produce any apparent disorganization; and it may therefore be imagined that more severe injury which occasions lesion of the retina would always be attended with destruction of its functions, or that amaurosis would inevitably ensue.

Such is not, however, the constant result of severe injury, as regards the entire retina, for

I have several times found that the loss of function has been confined to that portion alone of the retina in which disorganization has been produced by the injury.

I have observed the same fact in these cases, as in those in simple concussion, viz.: that if all perception of light be lost immediately after the receipt of injury, a perfect state of amaurosis remains, but if perception of light exists, the recovery of some useful or good vision is probable; but the surgeon should be cautious in forming his prognosis in consequence of the risk from subsequent inflammation. The extent of organic lesion may in some measure guide the opinion of the surgeon. I have found the lesions of the deeper tunics more manageable under the subsequent inflammation, than rupture or laceration of the sclerotic; indeed I hardly recollect an instance of the latter form of injury in which vision has been preserved.

The inflammatory action in the choroid and iris is readily controlled by moderate depletion, and the use of mercury, but that of the sclerotic often continues in spite of the utmost care of the surgeon; it induces much distress and suffering, and eventually other textures become involved in the diseased action, a general chronic inflammation of the globe is induced, and atrophy ensues. Such has been the termination of a large majority of the cases of ruptured sclerotic which have come under my observation; even in some in which I have had sanguine hopes of preserving useful vision (the larger portion of the retina having retained its functions nearly complete, for some time subsequent to the receipt of the injury), a slow inflammation has always defeated my expectations, although I have taken every pains to prevent it. After severe injury to the globe the iris often remains tremulous.

FUNCTIONAL DISTURBANCE OF THE ORBITAL PORTION OF THE OPTIC NERVE.

That portion of the optic nerve which is situated in the cavity of the orbit has occasionally its functions disturbed by pressure arising from disease of the osseous parietes of the cavity, or from morbid growths or enlargements within it; as by nodes, various forms of tumours, aneurism, &c., or from suppuration.

There is frequently some difficulty in deciding on the precise nature of a disease in the orbit; but it rarely happens that there is any doubt of the cause of the amaurosis in such cases: for example, the globe may be protruded, and vision be disturbed or lost, and the surgeon may be able readily to distinguish some morbid growth in the orbit which occasions the protrusion of the globe, and disturbs the functions of the optic nerve; but he may have great difficulty in determining whether such growth be of a fatty nature, encysted, or of a fibrous character.

The diagnosis, therefore, as regards the amaurosis is simple, but the prognosis, from the obscurity of the disease, or rather of the cause, is frequently difficult.

The amaurosis, in all such cases, is slow in its progress, and rarely complete, excepting when the optic nerve becomes implicated in the diseased action, and some organic change is produced in it.

Unless I were to enter into a full explanation of the diseases of the orbit, I could not, with any utility, describe their treatment, and in doing the former, I should far exceed the scope and limits of the present paper.

ORGANIC DISEASE OF THE OPTIC NERVE.

Organic change in the optic nerve is extremely rare; whether as resulting from disease which commences in it, or extending to it from the orbit, or even as the effect of violence.

If we could distinguish accurately the symptoms which attend the commencement of the morbid action which leads to organic change in the texture of the optic nerve, we might adopt some decided plan of treatment; but I do not know of any means of effecting this; and when the change has taken place, either from morbid action or from organic lesion, the amaurosis cannot be benefited by medical or surgical skill.

Most of the organic changes found in the orbital portion of the optic nerve do not originate in it, but are consequent upon disease which begins in the retina, or cerebral parts of the nervous apparatus of vision.

FUNCTIONAL AMAUROSIS FROM CEREBRAL DISTURBANCE.

This form of amaurosis is seldom complete or perfect, the function of vision being either partially interrupted, or generally obscured, but not destroyed.

Symptoms.—The patient either loses the perception of a part or parts of a large object; thus he may see the upper half of a face without being able at the same time to distinguish the lower half (hemiopia—visus dimidiatus,) or he may be able to perceive one side of the face only,—or the central part may be distinct whilst the lateral portions are invisible; or further, on the contrary, the lateral parts may appear, whilst the centre is obscured. Sometimes the extent of the amaurosis continues the same through the attack, but in other instances it increases so as to extend over the whole of the field of vision.

In these cases there is not any appearance of spot, spots, web, gauze, cloud, or other seeming intervening matter between the eye and object, as in choroiditis, but part or parts of the object are distinguished but very faintly, or are quite invisible.

Severe general headach, either precedes or follows the above symptoms, and the patient also suffers from nausea, with loss of appetite and general depression and chilliness.

The amaurotic affection seldom continues beyond a few hours, and evidently depends upon an irregular state of cerebral circulation sympathetic with the gastric or hepatic irritation or derangement.

Appearances.—The pupil is usually somewhat dilated and the look rather vacant, and the patient is pallid and cold.

I have myself experienced this form of amaurosis several times ; I had two or three attacks of it before the age of puberty,—they became more frequent about the adult period, and have latterly been of rare occurrence. With me the amaurosis has always preceded the headach, and nausea, &c. and has been evidently caused by gastric irritation ; but it has often come on at a time when the secretions were regular, and when the form had been of simple and plain kind.

I have been consulted by several fellow-sufferers of both sexes, and in some the cerebral pain has preceded the disturbance of vision, whilst in others it has occurred subsequently; and in a few the irritability of the stomach has been excessive and attended with violent vomiting.

I have remarked in my own case, and have found by inquiry in others, that the portions of nerve affected are not the same in each attack, but that the obscurity takes place in different positions and varies in its extent at different times.

I have known a similar form of amaurosis produced by the irregular cerebral circulation which sometimes follows concussion of the brain ; the affection has then been more continued, and of more gradual development, attended by giddiness, headach, noise in the ears, irritable stomach, &c., symptoms which cannot fail to indicate the nature of the disease, when viewed in connexion with the history of the case.

Treatment.—The cases depending upon gastric disturbance are best remedied by an emetic, followed by an active purge, or by a dose of mercurial and opium, and a draught of senna and some alkaline purgative salt a few hours after ; I have generally adopted the latter plan, and have seldom found it necessary to repeat the dose ; but on two or three occasions when I have neglected to attend to the attack at first, its recurrence three or four days in succession has at length compelled me to do so ; and I have been obliged then usually to take two or three doses. Attention to diet forms a necessary part of the treatment ; the patient should be careful as regards both quality and quantity of food for some time.

This affection, when caused by concussion, disappears as the cerebral circulation recovers its balance under the ordinary treatment.

ORGANIC AMAUROSIS FROM DISEASE OF THE BRAIN OR ITS MEMBRANES.

I have seen a few examples of incomplete or partial amaurosis resembling that described as functional with visus dimidiatus, &c., but of continued character, and unattended by gastric irritation or disturbance ; I place it under the head of organic disease, as I consider it to result not merely from an altered circulation, but to be caused by a morbid deposit.

I have seen only three cases of this kind, and in each the obscurity or loss of vision was partial, and the pupils rather dilated, with sluggish irides, but no perceptible change in humour or tunic : the disease was of slow progress, and affected one eye more than the other.

Each patient had been the subject of syphilis, and evinced some constitutional taint having periostitis or affection of the throat, or cutaneous eruption.

The indication for treatment was, therefore, tolerably plain : mercury was administered with care, (as I have previously described) and with the best effect in removing the imperfection of vision, as well as the other evidences of syphilitic taint.

Amaurosis resulting from organic cerebral mischief presents great variety in symptoms according to the seat, the nature, and extent of the change.

1. There may be partial or complete, imperfect or perfect loss of vision without any alteration in function in any part of the structures of the eye or its appendages except the retina, and without any visible organic change in the retina itself ; even the iris may act freely and rapidly although there be little or no perception of light, though most frequently the pupil is dilated rather more than natural and the iris moves tardily.

Such a form of amaurosis may have been preceded by headach or giddiness, and have been rapid in its progress, or have occurred very gradually without any marked symptom of cerebral disturbance : the latter, I think, is most common.

Under such circumstances one eye is often affected without the other, and if both are attacked, the amaurosis is more rapid in one than in the other, and frequently at the commencement of the disease the field of vision is not equally obscure.

As the amaurosis increases, the symptoms indicating cerebral mischief sometimes become developed, and the patient usually acquires the vacant aspect which is so general in blind persons.

When the amaurosis occurs rapidly the symptoms of cerebral disturbance are usually more marked than when it is of slow progress.

2. With the disturbance of vision there may be an occasional or constant appearance of double objects when the two eyes are employed, and this double vision will be generally more evident when the patient directs his attention to any object immediately before him ; whilst in a lateral direction objects may appear single.

The double vision in such cases is a consequence of loss of muscular power, by which the parallel motion of the two eyes is in part destroyed, and a squint (strabismus) is produced. When, therefore, the patient regards an object directly in front of him, the axis of the organs not being parallel, the object viewed is reflected upon portions of the retina which do not correspond, or rather which have not been previously associated, and a double impression results.

Most frequently the strabismus affects one eye only; but I have seen partial and complete paralysis of some of the muscles appertaining to each.

The direction of the squint, or the direction of the axis of vision of the affected globe, of course depends upon the seat and extent of the muscular paralysis.

I have frequently observed the degree of strabismus to be so slight that it would probably escape ordinary observation, especially under a lateral or oblique view of the eyes; but it is more commonly so obvious that it must attract the attention of the medical attendant on a superficial inspection.

It may be proper to observe that strabismus is frequent from other causes; when it usually precedes the amaurosis, (imperfection of vision being the result of the strabismus,) and affects only the eye which has its movements impeded or irregularly performed.

3. Of the nerves which supply the muscles of the globe, &c., the third and sixth are most frequently influenced by cerebral disease. I have not been able to detect paralysis of the fourth, and believe that the position of its origin and its course in the cranium render it little liable to be implicated in the most frequent cerebral disorders.

The third nerve is the one which most frequently suffers, and the muscles to which it is distributed have their power diminished or destroyed; and according to the degree in which the paralysis exists the following symptoms are more or less developed.

The superior lid drops, the globe is abducted and slightly depressed, so that the axis of vision has a direction outwards and slightly downwards, from the action of the abductor and superior oblique muscles, which alone retain their ordinary power; the pupil is somewhat dilated, and the iris moves very sluggishly or is fixed, and the vision is imperfect; and if the patient has sufficient power of vision to distinguish objects of moderate size with the affected eye, such objects appear double when regarded with both eyes, except when in such a position that the axis of the sound eye is necessarily rendered parallel to that which is nearly fixed in the direction I have mentioned; it is generally necessary to raise the superior eyelid to expose the globe and ascertain many of the appearances described; and if the patient endeavours to move about when the lid is supported by the finger he is not only confused by the double vision but suffers from giddiness.

In consequence of the falling of the superior palpebra, the disease has been named *Ptosis*, (from πίπτω, to fall).

The pupil being invariably dilated in these cases proves, I think, that the branch of the third nerve which joins the lenticular ganglion is distributed to the iris, and has a material influence on its motions; and further, the position of the globe with the axis of vision directed outwards and a little downwards proves that the action of the superior oblique muscle aids in directing the eye downwards and outwards.

Paralysis of the sixth nerve is much less frequent, and causes the axis of vision to be inclined inwards towards the nose; and when combined with amaurosis the pupil is not always dilated, but most frequently of natural size, and obeys the influence of light; the iris is however rarely so active as is natural.

4. There may be amaurosis with a fixed and protruding eyeball, and at the same time dropping of the superior lid, and dilated and fixed pupil; this results from paralysis of all the ocular muscles, and the globe having lost the support of the recti muscles, either falls forwards or is in a degree projected by the elastic cellular structure which exists at the back of the orbit.

These various modifications of amaurosis are caused by some cerebral pressure, as thickening of membrane or bone, effusions of fibrin, pus, or serum, as extravasation of blood, as the growth of various tumours; or they may be produced by the morbid change which has been termed *ramollisement.*

There are usually some general circumstances connected with the cerebral mischief which may aid materially in the diagnosis when the case, as regards the amaurotic disease, is otherwise obscure. Thus the attack may have been preceded by mental irritability and disinclination to employ the mind, and there may be sensible loss of muscular power, with the commencement and progress of the amaurosis.

The pulse is usually slow and laboured, but compressible; the extremities are cold and the surface pallid, and the patient frequently has cramps when recumbent, and snores much during sleep. There is, in fact, general evidence of diminished nervous susceptibility, in the want of activity in the principal functions, in most cases, and in the majority some symptoms which may, under patient investigation, enable the medical man to form a correct diagnosis; the importance of which will be made evident shortly.

Syphilis and scrofula dispose to organic disease of bone and membrane, which may occasion cerebral pressure and amaurosis, and the latter predisposes to the formation of tumours in the substance of the brain, or in connexion with its tunics.

Causes.—Injuries to the head, the effects of which are often very remote; fevers, with cerebral determination; *coup de soleil;* intemperance, gluttony, violent anger, excess of mental labour, and excitement, are the more immediate causes of cerebral mischief: whilst the sudden arrest of any material, natural, or habitual secretion or discharge, or the suppression of any long-standing or extensive disease, or anything which produces a sudden tension of the vascular system, predisposes to similar disease, and favours the occurrence of apoplexy or the development of slow inflammatory action: now and then we find an apoplectic diathesis, without any peculiarity of vascular action generally; but the most insidious cases are those in which the disease is induced by mental labour or anxiety not in great excess, but in persons subject to frequent or continued derangement of stomach, liver, or some important part or parts of the alimentary apparatus.

Amaurosis from cerebral disease of organic kind is frequent during dentition, and often occurs very suddenly, as other parts sometimes become paralysed, but in most instances it is slowly developed, and the consequence of serous effusion. I have also seen this form of amaurosis produced in children by the sudden suppression of extensive cutaneous eruption, or by checking a diarrhœa. From whatever cause the cerebral mischief arises in children, it is generally well marked by the ordinary symptoms.

The most insidious forms of the disease come on after the age of puberty, and are most frequent about and after the middle period of life; but from the variety of causes no particular period of life is exempt from amaurosis from organic cerebral change or morbid deposit.

The prognosis in these cases is favourable or not, according to the extent of disease, the rapidity of its formation, its continuance or its cause; thus, when in addition to the amaurosis, hemiphlegia, paraphlegia, or other form of paralysis evince extensive cerebral disease, the prospect of restoration of vision is very indifferent, especially when the disease has occurred suddenly and the amaurosis is complete or nearly so; and the probability of recovery lessens usually in proportion to the continuance of the affection. Further, the cause of the organic cerebral disturbance will sometimes render the prognosis unfavourable; for example, severe injuries to the head, extensive apoplectic extravasations, or sudden effusions during teething, or fever, &c. I also consider the prognosis bad, when the disease makes progress with little or no interruption, and offers scarcely any variety, being rarely stationary; never mitigating, but always more or less in advance under ordinary circumstances. This happens during the growth of some tumours, and under the change termed *ramollissement.*

Treatment.—In nearly all the cases of cerebral disease with a diminution of nervous power, the vascular system suffers in common with other parts, and the action of the heart and arteries frequently appears to contraindicate the loss of blood in the treatment of the disease,—the pulse being slow and easily compressible, the surface pallid, and the extremities and surface cold. Every medical practitioner must be familiar with such condition as consequent upon injuries to the head and apoplectic attacks, and have observed how the action of heart and arteries rises and becomes augmented in force and frequency under the judicious abstraction of blood, which relieves the cerebral pressure and thus restores nervous energy.

The same effect is sometimes produced on the vascular system by cerebral mischief of slower and more insidious character; and it is therefore occasionally found when amaurosis is present; and such cases so closely resemble an opposite form of disease, or that termed asthenic, that much care and discrimination are required in forming a correct diagnosis. I shall refer to the subject again after I have described the asthenic disease.

With very few exceptions, the treatment of organic amaurosis (cerebral) will be comprised under the following heads:—

1. Relief of vascular turgescence by general or local bleeding.
2. Prevention of further congestion or turgescence, by diet, mental and bodily quietude, and counter-irritation.
3. Promoting absorption of morbid deposit, by counter-irritants, mercury, iodine, &c.

1. General abstraction of blood is required in cases in which the amaurosis appears suddenly with giddiness, headach, torpor, or marked symptoms of cerebral congestion, as in injuries to the head, apoplexy, or after intemperance, gluttony, anger, or suddenly suppressed secretion or discharge; or suddenly repelled superficial disease, as in gout, erysipelas, &c. In the first instances the pulse may be slow, compressible, but laboured; in the majority of cases it will be full, incompressible, and perhaps quicker than usual. The blood should be removed by venesection, and in such quantity as to produce a marked effect on the vascular system; the orifice should be large, and the patient erect during the operation: and the pulse should be carefully watched during the flow of blood, so that the stream may be arrested as soon as a decided change is perceived in the beat of the artery. With such caution this part of the treatment can rarely do mischief, for the action of the heart and arteries readily indicates the amount of loss of blood which the system will bear: thus, whilst the young and robust patient may lose to twenty or thirty ounces of blood without marked change in the beat of the pulse, the old or feeble may evince such change in pulse after a loss of perhaps not more than six or eight ounces; yet in each case the desired effect may be equally well produced.

It is not by the amount of blood abstracted that good is effected, but simply by moderating the force or power of vascular action. The indications for a repetition of the operation consist in a return of the symptoms described.

I much prefer venesection to arteriotomy in the temporal vessel, as the latter necessarily leads to an interruption in the superficial circulation by division of the artery, or from pressure over the site of puncture, to arrest the flow of blood, and because I have observed the effect of this plan of abstracting blood to be frequently prejudicial, instead of beneficial, in severe cases of ophthalmic inflammation ; so much so, that I have for years abandoned it.

The local abstraction of blood by leeches or the cupping-glass is extremely serviceable in very many of these cases, either in addition to general blood-letting or singly. It should be resorted to in similar cases to those in which I have advised the general loss of blood, but in which the symptoms are not so urgent or marked. I prefer the use of the cupping-glass, and believe that the best spot for its application is behind and below the mastoid process : the removal of six or eight ounces of blood is sufficient in most instances at a time, and frequently, perhaps most frequently, a less quantity suffices in the commencement of treatment and before the influence of medicine can be established ; cupping may be repeated with advantage under any augmentation of cerebral disturbance.

Both general and local bleeding may be, and often are, carried to an injurious extent, by lessening power too much.

In children, delicate females, and very feeble persons, leeches would perhaps be preferable to cupping.

2. The observance of bodily and mental quietude is too obvious to need comment.

Diet must be proportioned to the strength of the patient, and urgency of the case ; generally a moderate mild nutritious form is the best ; extreme abstinence is rarely required, and sometimes during medical treatment even the use of stimuli, as beer, wine, or spirit may be essential.

Cases which are slow in their development and progress, such as result remotely from injury to the head, or are consequent upon fever, excess of mental labour, or are produced very gradually by suppressed secretion, discharge, or habitual disorder, seldom require loss of blood, but are better treated locally by counter-irritants, as blisters, tartar emetic, issues, or setons ; the two former modes of irritating are applicable to the cases resulting from injury to the head, fever, or mental anxiety or labour, and the more severe forms of issue and seton will be found most serviceable in such cases as have followed suppressed secretion or morbid action.

As a general rule, the medical man should endeavour to restore or promote the secretion or morbid action when it has been arrested, as the best means of subduing the cerebral disease.

3. The most powerful agent we possess of promoting or exciting absorbent action is mercury ; and this is the remedy most to be depended upon in effecting the desired purpose in the cases we are now considering ; the same caution and rules apply to its exhibition in these instances that I have detailed as requisite in the treatment of choroiditis.

Of the influence of iodine I cannot speak with so much confidence, but I consider it a very useful auxiliary in some cases.

I shall briefly recapitulate respecting treatment and the application of its particular forms to particular cases.

In those which result from injury to the head, from apoplexy, from intemperance, from gluttony, from excess of anger, or from sudden suppression of secretion, or morbid action, when urgent symptoms are present and the disease has been sudden in development :

1. General bleeding ; abstinence ; purgatives ; perhaps cold to the head.

2. Local bleeding ; counter-irritation ; moderate diet ; mercury, rather freely ; perfect quietude.

When the disease is more slowly developed, and cerebral symptoms less marked, as remotely after injury to the head, or from excess in food, from mental anxiety, as after fever, or from suppressed secretion or morbid action :

1. Local bleeding, by cupping.

2. Counter-irritation ; moderate diet ; mercury more slowly ; quietude.

In the most insidious cases, where the symptoms of cerebral disease are very slight, and the progress of the disease extremely slow, as from many of the above causes, or from syphilis or scrofula :

1. Counter-irritation, and attention to secretions, with moderate diet.

2. Counter-irritation ; mercury or iodine, separately or together.

When there is marked syphilitic taint, or decided strumous diathesis, the power should be maintained by good nutritious diet, and mercury be administered cautiously ; and in many of these cases I believe that iodine will effect more than mercury, or that it will materially aid the latter remedy.

I have seen so many cases deemed hopeless recover under steady and continued means, such as I have described, that I recommend them with confidence : it frequently happens, however, that little immediate good results, especially in the more slowly developed and insidious disease ; but I have found that a steady perseverance has accomplished that which a moderate trial of the remedies had given little hopes of. I have gone on with a careful alterative course for months together, when the power of the patient has allowed of it, and have occasionally succeeded when hope had almost disappeared.

There are three consequences of cerebral disease found with amaurosis, which are not much under the control of the remedies I have described, or indeed of any others that we are acquainted with ; they are the serous effusion constituting hydrocephalus, purulent effusion or abscess, and some forms of tumours. The first is perhaps most readily distinguished, and may be frequently combated with success in the early stage, but after a certain progress our remedies are of little avail. Counter-irritants and mercurials are, I believe, the most efficacious means.

In cerebral abscess, the symptoms are often very obscure ; and I believe that if it could be recognised, nothing short of operation would afford much chance of safety.

Even more obscurity exists in the development of tumours, and there appears but little probability of ever forming an accurate diagnosis respecting many of them. I consider, however, that the treatment recommended for amaurosis from cerebral organic mischief, is that best adapted to prevent, retard, or subdue such morbid growths.

I have not had sufficient opportunity of seeing and examining cases of softening of the brain, *ramollissement*, to venture to express my opinion respecting its treatment.

The last forms of amaurosis which I have to describe result, I believe, in most instances from altered vascular action throughout the whole nervous apparatus of vision: they are not at first attended with any visible change of structure, and are therefore of a functional kind; but under a continuance of the disease, morbid alterations ensue.

I shall make two principal divisions:

1. That which results from excess of the vascular action, and which has received various appellations, as acute, tonic, sthenic, plethoric, congestive, &c.

2. That which is produced by a deficient action or inadequate supply of red blood, and has been termed chronic, atonic, asthenic, &c.

FUNCTIONAL AMAUROSIS FROM EXCESS OF VASCULAR ACTION.

This may arise from a general fulness and tension of the vascular system, or depend upon a partial turgescence or fulness, from irregular arterial action or venous congestion.

When there is a general tension of the vascular system the symptoms are usually well marked. There is general head-ach, giddiness, feeling of heaviness or torpor; the amaurosis is most frequently of gradual development; and the patient describes objects as if seen through a mist, cloud, or network, and sometimes as invisible in part, parts, or *in toto*, without the intervention of a cloud, &c. The condition of vision depends, I consider, upon the principal seat of vascular pressure, differing, as I have before remarked, according as it may be cerebral or choroidal; there is also a sense of fulness about the head and eyes, with heat.

Appearances.—The eyes sometimes appear slighty protruded; the conjunctiva exhibits more red vessels than natural; the pupils are at first often contracted, but if the disease continues a few days they become somewhat dilated, and the motions of the irides sluggish: the face is frequently flushed, and the patient either restless and anxious, or heavy and inclined to sleep, and during sleep he snores loudly. All these symptoms are augmented after a full meal, or by position from which the cerebral circulation is facilitated.

The skin is hot, and the pulse full, bounding, and incompressible.

Causes.—Indulgence in the luxuries of the table without due attention to the secretions, especially of the bowels, is the most frequent origin of the vascular fulness; and this effect is most prevalent in those who have sedentary occupations, and are prevented from taking exercise. Now and then the plethoric state results from two or three acts of excess in diet, in rapid succession, and then the symptoms are usually more urgent and severe.

The same condition of circulation with cerebral determination comes on more slowly in consequence of arrest of inordinate secretion, or discharge, or the suppression of some long standing or habitual disorder.

When the vascular system has become turgid from any circumstance, an amaurosis is easily promoted by much exertion of vision.

This form of amaurosis is seldom found in very young persons, and is much more prevalent about the middle period of life than in those of advanced age.

It usually affects both eyes in an equal degree.

Treatment.—Speedy relief is obtained as regards the amaurosis by lessening the tension of the vascular system; and this is best effected by the general abstraction of blood; by venesection, so as to produce a decided effect on the circulation at the time. Subsequent repletion should be prevented by great attention to the secretions and diet, in the cases which have arisen from excess of food or stimulus; but in those instances in which inordinate secretion or discharge, or habitual disease, has been checked or suppressed, an endeavour should be made to promote a return of the secretion, &c., or a drain should be established for a time, by seton or issue, in addition to the remedies that I have previously mentioned.

The formation of issue or seton at any part will, I believe, produce the desired effect on the circulation, but a more immediate relief may perhaps be afforded to the amaurosis, by placing the counter-irritant in the neck.

If the patient will not submit to the formation of issue, &c., he should be purged frequently and actively.

When the amaurosis results from increased cerebral circulation or congestion, without a general fulness of the vascular system, the symptoms only vary from the foregoing in degree, and in general character. There is usually headach, giddiness, sense of weight or heaviness in the eyes or forehead; the loss of vision is in most instances gradual, and occurs with much variety of cloud, gauze, &c. Further, the pupils are often at first contracted, and subsequently dilated, and all symptoms are increased by stooping, or becoming recumbent.

There is not, however, heat of skin, redness of eyes and face, or much general torpor; and the pulse often indicates rather a feeble power, being quick and easily compressible, than too much force of arterial action.

The causes of this irregular vascular action are so numerous and various, that there must necessarily be some modifications of the symptoms.

Most frequently the irregularity of circulation is sympathetic with gastric, hepatic, or intestinal disturbance, as in ordinary dyspepsia, or when the stomach is disordered by improper diet, or by the influence of particular food, or by some poisons. Again, intestinal irritation from worms or scybala will produce a like effect.

With the gastric or hepatic disorder there will probably be loss of appetite, nausea, uneasiness, tenderness at the epigastrium, with sallowness or yellow aspect, and depression of mental and bodily activity.

With the intestinal irritation there will usually be found irregular state of bowels; occasional nausea; some abdominal uneasiness or tenderness, with restlessness; mental irritability, and disturbed sleep, with horrid or distressing dreams, and sometimes fever.

In many instances, however, when there exists gastric or intestinal irritation, the evidences of such mischief are so trifling that it is often overlooked, and the cases are regarded entirely as cerebral; and improper treatment is consequently adopted and persisted in.

Some remarkable modifications of amaurosis exist, which I consider as properly belonging to this division; because in many instances the symptoms of gastric irritation are well marked; and further, in consequence of the disease being relieved by remedies appropriate to gastric disturbance.

The modifications which I allude to are the marked intermittent varieties of amaurotic disease, sometimes irregular, but most frequently with regular periods of duration and intermission.

The most common of these varieties of the disease is that in which the patient has the vision obscured at sunset, and becomes relieved of the obscurity at sunrise; usually the patient loses the perception of objects of moderate size, but occasionally retains only perception of light during the attack. From the patient being able to see during the day, the disease has been termed Hemeralopia, from ἡμέρα, day, and ὄπτομαι, to see.

Hemeralopia is exceedingly common both in the East and West Indies, and especially attacks the crews of vessels stationed off certain parts of the coasts or islands. It is most prevalent during the fruit season, and has frequently (I think with much propriety) been ascribed to imprudent indulgence in this tempting article of food, which produces gastric or intestinal derangement.

It is attributed, by the sailors, to the influence of the moon, believing that it is produced by the moonbeams falling on the eyes, if they imprudently sleep exposed to them; hence the disease is by sailors called moon-blindness.

The attacks of blindness generally occur every night, but I have heard of variations in the periods of relief, so that the disease has put on a tertian or quartan form, like ordinary intermittent fever: only one case of such variety has come under my observation and care; then the amaurosis occurred every second evening, or assumed a tertian form.

Occasionally the amaurotic symptoms take place at sunrise, and disappear at sunset; this variety is very rare, and has been denominated Nyctalopia, from νὺξ, night, and ὄπτομαι, to see, as the patient has visual power during the night.

The variety of the disease, which results from the influence of some poisons on the stomach or alimentary canal, presents modifications of symptoms according to the quality and quantity of the poisonous matter introduced into the stomach, which I have not space to describe.

Treatment.—In the ordinary cases of gastric and hepatic derangement, attention to the secretions, and strictly regulated diet and exercise, form the principles of treatment; the subject is, however, much too extensive for me to endeavour to explain further in the present article.

Amaurosis from gastric and hepatic irritation is most frequent in persons about the middle period of life, but it is not rare in those more advanced in age.

Disturbance of cerebral circulation, with amaurosis from intestinal irritation by worms or scybala, is, on the contrary, rare in adults, and frequent in children or young persons. The former usually occasion nasal and anal irritation, and frequently inordinate appetite; whilst the latter produce nausea, loss of appetite, and much general restlessness.

In children between the first period of dentition and the time of puberty, these are the most frequent cases of amaurotic affection.

To remove ascarides or lumbricales, I know of no remedy so efficacious as calomel and scammony, or mercury, with some drastic matter; and a careful avoidance of green vegetables, fruits, &c. Turpentine as a remedy for tinea is so well known as scarcely to need mention here.

To effect the removal of hardened fæces or scybala, two remedies may be employed separately or conjointly, viz., purgatives and enemata; in my opinion both may be used with much advantage, but the latter are especially serviceable when the irritating matter occupies any portion of the left part of the colon: here again, the best purgatives are those of drastic property; I have several times seen cases in which the purgatives in common use, as senna and salts, rhubarb and magnesia, infusion of roses, and salts, &c. have been employed, and have acted freely on the bowels for days together, without dislodging the offending substance; and subsequently this has been effected readily by one or two moderate doses of calomel and scammony, or calomel and jalap; such instances must be familiar to all observant medical men.

The severity of the cerebral symptoms in some of these cases, induces the medical attendant to consider the disease as existing there; and the gastric or intestinal irritation as sympathetic, and it often requires a careful attention to the tongue and to the character of the secretions, as well as cautious examination of the abdomen, to form a correct diagnosis. Having seen frequent error in this respect, I consider it a duty to notice it particularly.

In all the cases of hemeralopia and nyctalopia which have come under my care (and of the former disease, I have seen numerous instances,) a cure has readily been effected by regulating the secretions, and pursuing a plan of diet, of nutritious, but not stimulating kind; and when a healthy state of secretion has been restored, if the disease has not disappeared, a few doses of quinine or bark have speedily subdued it.

We have not much opportunity of seeing the severe forms of these affections, but the accounts we have from medical men who have witnessed it in its worst degree confirm the opinion I had formed and have expressed respecting it.

Probably from its occurring particularly off certain stations, and from its peculiar type, as well as from the influence of quinine in very obstinate cases, we may fairly infer that it frequently results from a specific cause, which at the same time stirs up disorder in the digestive organs.

I have known cerebral determination with amaurosis sympathetic with two other conditions of distinct irritation, as during teething and during pregnancy.

Most medical men must have witnessed the frequent cerebral disturbance which occurs during the period of dentition, and must have witnessed some of the distressing effects of the continuance of this disturbance; amaurosis is one occasional consequence of such mischief.

From irregular vascular action induced by uterine irritation during pregnancy, similar effect sometimes results, and several remarkable cases are recorded.

The symptoms in either instance correspond closely to those already described, as resulting from gastric, intestinal, or other distinct irritation; but the disease is in each case limited to certain periods of life, during which alone the particular causes can exist.

I have considered these varieties worthy of separate consideration, because demanding some modification of treatment; thus the irregular cerebral circulation which occurs during dentition is speedily relieved by a free use of the gum lancet, with a careful diet, and regulation of secretions; whilst that which occurs during pregnancy usually requires little more than attention to the last-named particulars, with perhaps occasional abstraction of blood locally by leeches; for the loss of a very small quantity of blood suffices to relieve any urgent symptoms, and as the irregular vascular action cannot be entirely subdued during the continuance of the exciting cause, it would be folly to pursue medical treatment further than may be requisite to prevent severe or permanent cerebral disease.

Further, this form of amaurosis is occasionally produced from a more immediate cause, viz. from the pressure of some cervical tumour which impedes the circulation of the brain by pressing upon the carotid artery or jugular vein. The tumours most frequently formed in this situation are glandular or aneurismal; but sometimes those of encysted or adipose character are developed.

Error in diagnosis is hardly possible in such cases, and the mode of relief is obvious, though not always attainable.

FUNCTIONAL AMAUROSIS FROM DEFICIENT SUPPLY OF RED BLOOD.

In these cases there always exists I believe a want of general power and vigour of circulation at first, but in some instances of long-continued affection of this kind, the local circulation never regains its proper force and fulness; and the supply of blood is inadequate to support the functions of the part, although the general system recovers its natural tone and power.

Symptoms.—The disturbance of vision is gradual, and its degree frequently varies at first; the patient generally complains of giddiness, and headach, and the pain is usually confined to the forehead, to the summit of the cranium, or to the occipital region; these symptoms are much relieved by quietude, by the recumbent posture, by a nutritious and slightly stimulating meal, or anything that increases the power of circulation, whilst they are augmented by immoderate exercise, abstinence, or whatever tends to lessen general power.

Appearances.—The pupils are generally dilated, and the motions of the irides slow; the conjunctiva and sclerotic have usually a blanched appearance, the face is pallid, and the patient has a distressed expression of countenance.

Generally the patient is chilly, has cold extremities, is restless and watchful, and the pulse is quick, somewhat feeble, and easily compressed, although the pulsation is accompanied, in some persons, with a marked jerk. Often the patient is morbidly irritable and fretful.

Causes.—All circumstances which tend to exhaust the vital fluid promote the asthenic amaurosis,—as hæmorrhages, uterine, hæmorrhoidal, nasal, or from wounds; excessive secretions, as in menorrhagia, diarrhœa, or in seminal discharges, from inordinate venery or onanism; or too much or too long-continued sucklings; profuse discharges from ulcers, &c. have a similar effect, as well as a deficiency of food, or bad food, and some poisons; and the operation of these causes is much augmented by hysterical diathesis, by influence of mind, &c.

Persons naturally of feeble power are most subject to this form of amaurosis, and it occurs most frequently between the period of puberty and the middle period of life.

Treatment — consists in first subduing or removing the source of exhaustion, as by checking loss of blood, or inordinate secretion or discharge.

Suppression of hæmorrhage, which is not in extreme, can be generally accomplished with facility; but when it has been long continued, caution should be used in subduing it, and in subsequent treatment, or a state of plethora may be induced.

We but rarely find asthenic amaurosis as a consequence of exhaustion from diarrhœa, dysentery, menorrhagia, or leucorrhœa; I have, however, known the vision affected under such circumstances, but the cases have been of trivial extent, and the amaurosis has quickly disappeared, as the cause of debility has been subdued.

On the contrary, asthenic amaurosis is frequent during lactation, either in young and delicate mothers who have to support large infants, and endeavour to effect this entirely by the breast, or in such as prolong the period of nursing in spite of exhaustion. In all such cases the child should be taken from the breast as soon as possible.

We have much more difficulty in suppressing the cause of exhaustion in those addicted to excess in venery or to private gratification of sexual passion. There is something peculiar and almost indescribable about the appearance of persons debilitated from such causes, that I can detect the cause very generally from the aspect of the patient; it is a mixture of anxiety, restlessness, and intolerance of society, which must be witnessed to be appreciated: this is particularly to be observed in those who practice self-gratification.

In either instance it is useless to attempt a cure unless the patient refrain from his pernicious vices. The practice of onanism, (which often leads to much more serious disease than amaurosis) becomes in some instances so confirmed a habit, that (like dram-drinking) the patient appears incapable of refraining from it, and it becomes necessary to have him incessantly watched for months before he can be cured of the unnatural propensity: probably the effect of this vice upon the mental power has much influence in lessening correct feeling and destroying moral courage.

Excessive purulent discharge which gives rise to asthenic amaurosis is generally connected with extensive disease of bone, or proceeds from a largely-exposed surface, and it usually exhausts the patient, unless the diseased part can be removed by operation.

The debility resulting from deficiency or improper form of food, has its obvious and certain remedy, except in very extreme cases.

Deficiency of red blood in the smaller vessels I consider to be the cause of diminution or loss of function in the retina which occurs in very elderly persons, in whose eyes we cannot detect any organic change.

Rest, and the recumbent posture tend materially to check cerebral mischief and amaurosis in all of these cases. The cause of exhaustion being suppressed or mitigated, the next object of treatment should be to restore power and maintain it.

This is to be effected,

1. By good nutritious diet: food should be taken at short intervals, in moderate quantity, so as not to overload a weak stomach; and a portion of stimulus such as the patient has been accustomed to will be serviceable, but it must be cautiously given, because under circumstances of much debility it is apt to produce over-excitement, which is always prejudicial; when its exhibition is followed by flushing, restlessness, and headach, it should be laid aside for a time. In these cases there is often a relish for sour and indigestible food, which should of course be forbidden.

2. By mental and bodily quietude; which are essential, as preventing further loss of power, and as aiding the operation of other remedies.

3. By medical agents, the best of which are the preparations of iron, of zinc, of bark, of strychnine, &c., and, in some cases, narcotics, and anti-spasmodic or anti-hysterical remedies are necessary.

According to my experience, the preparations of iron are by far the most valuable of these remedies, as promoting the formation of red blood, and increasing the vigour of the circulation. I prefer small and frequently repeated doses to large doses. In very young and delicate patients I usually give the vinum ferri, and commence with doses of ten minims, and even less sometimes; in those of more advanced age I employ the compound steel mixture, in half-ounce doses to begin with, or the sulphate of iron in substance in pill; and I have used largely a tartrate of iron, made by mixing fine iron filings with the crude supertartrate of potash (equal weight of each); the mass is covered with distilled water, and submitted frequently to alternation of heat and cold, being occasionally boiled, and afterwards exposed out of doors; fresh portions of distilled water are added from time to time, and the whole is frequently stirred: when the preparation has acquired a uniform dark reddish brown colour it is fit for use; of a saturated solution in distilled water, I prescribe from half a drachm to two drachms twice or thrice in each day. The preparations of iron are especially serviceable in those cases which result from hæmorrhages, from menorrhagia, from excess of lactation, or from inordinate seminal discharge.

When the cure is tedious, I find it advantageous to vary the form of the remedy occasionally, and to give it in combination with other preparations, as the sulphates of iron and zinc together, in pill or solution, or either, with the compound galbanum pill, or with ammonia, or other anti-spasmodic; these are useful additions when there is a marked hysterical diathesis; and when excess of nervous irritability exists, conium, hyoscyamus, opium, &c. may be beneficially employed.

The occurrence of headach, or a sense of tightness about the thorax, forbids the continuance of steel, or demands a diminution of the dose employed.

The preparations of bark are generally incompatible with the use of iron, but they are often of the utmost service in cases in which the latter remedy does not agree, and some preparations may be combined with great advantage, as the sulphate of iron and quinine. I think the concentrated forms of bark the best in the cases we are now considering, as the extract, the liquor cinchonæ flavæ, (of Mr. Battley) quinine, &c.

After diarrhœa or dysentery, or in cases of profuse purulent discharge, the preparations of bark are usually preferable to those of iron.

In some few cases I have employed strychnine in small doses as a tonic, (grain $\frac{1}{12}$) and with benefit; I believe that its specific effect from larger doses would be injurious.

The medical treatment must be modified according to the peculiar features of the case; the object is gradually to increase power and promote the formation of red blood; the appropriate remedy must be selected by the medical attendant, it would be almost an endless as well as useless task (in my opinion) to attempt to explain more than I have done in reference to the treatment of the numerous modifications of asthenic amaurosis.

I have already alluded to the close resemblance which exists between some of these cases, and those in which the amaurosis is caused by cerebral pressure; and the consequent liability to mistake in diagnosis and treatment; this point, perhaps, will be best illustrated by a few cases.

A young and delicate female, about seventeen years of age, having great nervous susceptibility, and disposed to hysteria, was accidentally thrown from a gig with her father, who was a very large man. She fell upon her father, and was taken up without any mark of injury; she was however dreadfully alarmed, and soon after attacked with a violent fit of hysteria: several hours elapsed before she could be roused from this under the use of the ordinary treatment, by stimuli, anti-spasmodics, &c. She then complained of excessive headach, with giddiness, confused vision, and heat of head; the stomach was irritable: she suffered from great mental depression, and could not procure sleep. Whilst in this state her medical attendant (believing that she had received some concussion of brain by her fall) bled her: she fainted after the loss of about eight ounces of blood, and remained a long time in a condition approaching syncope. In a few hours afterwards her previous symptoms were renewed and became much aggravated, the headach almost intolerable, the depression excessive, and the affection of vision increased, so that in forty-eight hours after the venesection she could not discern light. A few hours after the amaurosis was complete, she was brought to me, still labouring under the symptoms last mentioned; but, in addition, I found her pallid, with cold extremities, and a quick, feeble, and easily compressible pulse: the result of the abstraction of blood was sufficiently indicative of the nature of the affection, and to prove its asthenic character. I directed perfect quiet, the recumbent posture, small portions of nutritious matter to be given frequently, ten drops of the vinum ferri to be taken in weak wine and water every four hours, and an occasional dose of the compound decoction of aloes with manna, and a few drops of aromatic spirit of ammonia as an aperient. In forty-eight hours from the time I prescribed for her, her symptoms were greatly mitigated, and she began to perceive light again; she soon recovered her ordinary condition of health, and lost her headach, feeling of depression, &c., but the functions of the retina returned very gradually; so that several weeks elapsed before she could tell the letters in the title page of a common octavo work; being so far restored, I lost all knowledge of her for several months, when she was again brought to me nearly in the same state as when I first saw her; her father had failed in business, and she had suffered much from anxiety and privation, and had neglected all treatment. I put her under the same plan of treatment again, gradually increasing the dose of steel, and occasionally varying the form of medicine; her health was rapidly re-established, and a very slow improvement took place in vision, but after many months' careful perseverance in the above means she obtained only sufficient vision to be able to make out a large print. I subsequently tried blistering, electricity, galvanism, and strychnine, but without any further benefit.

Connecting the early symptoms of this case with the fall, many medical men would probably have treated it in the outset in the same way. Had there been a careful examination of the pulse and circulation, and had the condition of these been carefully viewed with the other symptoms, it would have been perceived that the cerebral symptoms could not be depending upon excess of vascular action; the pulse which exists, in cases of cerebral mischief from injury, is either quick, sharp, and incompressible, or slow, laboured, and of moderate force. I have never found, under such circumstances, the quick, feeble, and easily compressible pulse, which occurs in most asthenic diseases.

A gentleman, about thirty years of age, tall, well formed, and strongly made, consulted me in consequence of his being nearly blind, having only the perception of large objects.

Belonging to an opulent family, he had availed himself of the opinions and advice of nearly all the medical men of eminence in the metropolis, and also of several provincial medical men: all whom he consulted viewed the case as one of cerebral disease of sthenic character, and the remedies employed were local and general bleeding, all the varied forms of counter-irritants, cold lotions, shower-baths, mercury, purgatives, abstinence, and, in fact, all means calculated to lessen power and subdue any acute action. He only obtained some temporary relief from headach from loss of blood, but always had it in an increased degree soon after; otherwise, he continued gradually to get worse. When I first saw him he had amaurosis in the extent mentioned, severe occipital and cervical pain, which was constant; he was giddy; he suffered from constipation and dyspepsia; he was impotent, and had numbness and deficient power in his thighs and legs, so that he could not walk steadily without assistance, and he was incapable of making any great mental exertion; he had lost flesh considerably, was pallid, with cold extremities, and had a quick, feeble, and compressible pulse; his symptoms were somewhat mitigated by a nutritious meal, and by the recumbent posture. I had no doubt from these symptoms that the disease was of asthenic character at that time, but felt some doubts as to its mode of origin or commencement and progress, in consequence of the uniformity in the opinions of so many medical men of high reputation; but a careful inquiry into the history of the case soon satisfied me that the opinions previously given and acted upon, had been formed too hastily and erroneously. The patient, with good person, and ample means, had entered the army when young, and as opportunity occurred he indulged to excess in sexual intercourse—so much so, as frequently to render himself incapable of ordinary exertion for days together; after a few years his sexual power began to decline, although the venereal appetite continued; and he suffered from frequent nocturnal seminal discharges, when he was almost impotent in other respects; he then begun to lose vision, objects appearing cloudy, and he experienced frequent headach and giddiness, the pain being generally about the occipital region; from this period, under various medical advisers, he was almost uniformly depleted, and by degrees he acquired the melancholy train of symptoms which were present when I first saw him.

I directed him to obtain apartments in a quiet situation; to avoid all society likely to excite him; to take exercise twice a-day in fine weather, for a short time, not so as to create fatigue; to clothe himself warmly, and to recline on a sofa frequently in the day. His diet was to be nutritious, animal food at breakfast and dinner, and a moderate quantity of wine with the latter; the meals to be taken with great regularity, to dine early, and to be careful not to distress the stomach by quantity of food; he was to use a shower-bath every morning on rising, from which he had previously experienced some benefit, feeling refreshed and with more energy from it. At first I prescribed small doses of the vinum ferri, and then the sulphate of iron in substance in pill; afterwards I added a small portion of sulphate of zinc to the pills; the doses were small and frequently repeated. A few weeks after he had commenced this plan a very marked improvement took place; the pains in the head entirely subsided, he experienced very trifling giddiness, the nocturnal seminal discharges became much less frequent, the dyspepsia diminished, he felt more general power and energy, and he began to discern objects about his room which he had no previous knowledge of. By a steady perseverance of more than twelve months he was perfectly restored to health and sexual power, but he only regained sufficient vision to enable him to see a large print or letter, and consequently to guide himself about, and to recognise all ordinary objects in a favourable light. Within twenty months from the time of my first seeing him he married, and is now the father of two fine children; his health has continued excellent, and his vision has, in a trifling degree, improved.

I consider this as a highly interesting and instructive case, evincing the fact I have insisted upon as regards the error in diagnosis in these cases, and proving the necessity of careful and extended inquiry into the history and progress of disease. Several whom the patient consulted, I am satisfied, never would have committed such great error in diagnosis, and consequently in treatment, had they patiently gone into the history of the disease.

I could mention many other cases illustrative of this important point.

On the other hand, there is sometimes much difficulty in discriminating cases in which the amaurosis is produced by cerebral organic mischief from the asthenic cases. I shall relate two cases which will fully explain this:—

A lady about forty years of age became the subject of amaurosis, nearly complete in one eye, and imperfect in the other, a few weeks after miscarriage, during which (it was stated) she lost a large quantity of blood: the amaurosis had been rather rapid in its progress. She was brought to London after several weeks had elapsed, and she had undergone rather active treatment by cupping and mercurials principally; leeches and blisters had also been used, but the disease had advanced. I was requested to see her, and found her very pallid, with cold extremities, feeble, rather quick and compressible pulse, great despondency, and prostration; slight strabismus existed; the right eye-ball projected rather more than the left, and its visual power was almost gone; the left eye retained sufficient power to distinguish large objects,—the pupils were dilated and fixed; a degree of numbness and loss of muscular power affected one side of the face: she suffered from constant dull headach, which was relieved in a degree when she assumed the recumbent position. The general symptoms and non-effect of depletory treatment connected with the history of the case, especially the circumstance of large loss of red blood, gave it the character of asthenic disease, whilst the strabismus and partial paralysis of face, created strong suspicions of some organic cerebral disease. I considered that there might be some partial serous effusion or softening about the brain, to account for the last mentioned symptoms, and yet the case be one of asthenic kind, for I have no doubt that organic changes can and do take place, and often with frightful rapidity, when the general power is much below par. Under this conviction I prescribed much as in the last-mentioned case, and was deceived by some degree of improvement, for she became easier and had more animation about her. After a short time, however, she again began to decline, and in a few weeks died with more evident symptoms of serious cerebral disease. On post mortem examination a large abscess was found in the left hemisphere of the cerebrum extending into the anterior and middle lobes. I believe that the suppuration had commenced before I saw her, and that medical or surgical skill could have availed little, even with correct diagnosis. This, however, does not lessen the interest of the case, which presented a train of symptoms extremely complex, and which could very rarely be observed again. The patient was not in a state to give me any detailed account of her early symptoms, and the statement received from her medical attendant in the country was little more than a history of the treatment that he had adopted.

My friend Mr. Walker, of St. George's Hospital, requested me to see a lady about twenty-eight years of age, who was the subject of amaurosis complete in the left, and nearly so in the right eye. The pupils were of different sizes, the left rather the largest, but not much dilated; the motions of the irides were very sluggish, and there existed a very trifling degree of strabismus. She was pallid, with cold extremities, and complained of great mental and bodily depression; she was most easy when allowed to be perfectly quiet and reclining, but not perfectly recumbent; her pulse was feeble, and compressible, but not rapid. All these symptoms had come on shortly after miscarriage attended with flooding, as she said, to a frightful extent. So far the case had the marked characters of the asthenic form; but the condition of the pulse, which I thought to be laboured, and the existence of slight strabismus, made me hesitate and inquire further, when I discovered that she was very uneasy when perfectly reclined, and whilst in such position that she suffered much from severe cramps in the limbs. I had then no longer a doubt of the nature of the case, and immediately directed her to be cupped behind the mastoid process, and began the exhibition of mercury, enjoined quiet, and a simple light diet.

The mercurial treatment was carried to an extent to affect the mouth, but not severely; her recovery was perfect in about six weeks. Had I hastily formed my diagnosis from the prominent features of the case, and taken as a fact the important statement about the flooding, I should have treated the patient as suffering from asthenic disease, and probably have induced a fatal termination. I have seen many other cases in which a superficial view and examination might have led to most serious error.

CONGENITAL AMAUROSIS.

Many instances of congenital blindness are connected with mal-formation of the organ,—they are evident and irremediable.

In some cases the eyes are well formed, and even the functions of the iris perfect, but no perception of light.

In others, with a well-formed organ, there is a very imperfect function; the distinction of light from darkness being all the patient is conscious of, and even this is lost as the person advances to puberty.

It is very difficult in the first few weeks, and sometimes for months, to tell decidedly whether a child be amaurotic or not, when the eyes are well formed; but all doubt is soon cleared up when the period arrives at which a child usually begins to take notice of surrounding objects, for the aspect becomes vacant and unmeaning, instead of animated and intelligent.

When congenital amaurosis is imperfect, and the child discerns light, and perhaps would be capable of seeing large objects, a remarkable involuntary motion of the globes is acquired, and is ever after retained, although complete loss of sight ensues: generally it is a rolling of the eye-ball, sometimes a kind of oscillation; it is, I believe, acquired by the constant and eager search after light.

I believe that all the congenital amaurotic affections depend upon deficient development in some part of the nervous apparatus of vision, and that they are consequently beyond the reach of our science or art; they are occasionally confounded with cases of amaurosis from cerebral mischief, which are frequent in children, and often admit of relief as I have described.

I shall conclude with some brief observations upon the divisions and subdivisions of the subject, upon the pathology of the disease, and upon its treatment.

The division that I have adopted has been the result of very extensive observation and careful consideration, in which it has been my constant endeavour to elicit practical good, and I trust that I have exposed the general and principal symptoms appertaining to each form of the disease, with sufficient clearness, to render the majority intelligible to the well-informed practitioner.

Perhaps some varieties of the disease would have been rendered more distinct by being illustrated by cases, but I have purposely avoided the introduction of more cases than I considered essential to perfect explanation.

It must be understood that I have confined myself to the description of those forms of amaurosis most generally met with, and have endeavoured to mark the boundaries of each form. There are, however, frequently combinations and modifications occurring, which I have not yet worked out sufficiently to make their introduction here of much utility; they are, indeed, like the combinations and modifications of many other diseases, of such variety, and often of such intricacy, that I believe only very few will admit of distinct and useful exposition.

The subject altogether is, in my opinion, far from complete, and I think it probable that further observation and experience may induce me to modify the present arrangement.

I do not pretend to any merit or novelty in my arrangement of the subject,—it partakes of many that have preceded it, though I believe it does not resemble any one *in toto*.

On the pathology of amaurosis little can be said, for little is positively known; various morbid changes have been discovered in the retina, the optic nerve, and in the cerebral part of the nervous apparatus; but these discoveries have, for the most part, taken place at a period remote from the occurrence of the amaurosis, and we rarely have opportunity of inspecting the condition of these structures anatomically in cases of recent disease, therefore we cannot accurately decide upon the exact changes which produce several forms of amaurosis.

Many of the changes in structure which we find in our examinations of amaurotic cases, I believe to be the effect, and not the cause of the loss of vision; this happens especially with respect to the optic nerve, which nearly always loses its natural character under continued amaurosis which has been of cerebral or retinal origin; the performance of its appropriate functions appears to be essential to preserve the integrity of each part; and if the function be annihilated the part usually undergoes some alteration. The result of post mortem inspection of cases of amaurosis would lead us to suppose that atrophy of the nerve was the most common cause of the disease, but I believe that we should greatly err in coming to such conclusion solely from the fact observed so frequently in the dissection.

Further, the changes discovered after death in the retina, or in the cerebral portion of the nervous apparatus, may be produced by morbid action, subsequent to the amaurotic disease; in fact, the truth can only be obtained on these points by careful examination of these structures, during the progress, or at the completion, of the amaurosis; and our opportunities of doing this are so rare, that a very long time must elapse before any positive conclusions can be formed. These circumstances must retard the progress of our inquiries, and our endeavours to perfect this division of ophthalmic diseases. I fear that we shall not comprehend some of the more intricate cases, until recent dissection shall have much advanced our pathological knowledge of the disease. It is true that in a great majority of amaurotic complaints, a careful inquiry into the history and symptoms of the cases enables us confidently to form our opinion of the seat and nature of the disease, but there are many cases which are obscure from our ignorance of the nature of some of the pathological changes.

I have but slightly mentioned, or in some instances have altogether omitted, to notice many general and local remedies which have been strongly recommended by others as serviceable in the cure of some forms of amaurosis; the reason is, that I have tried them, and found them almost useless.

As general remedies, I may mention phosphorus, arnica, strychnine, emetics, &c.; the two last I have described as serviceable in some cases; the former, as a tonic in small doses, in asthenic cases; the latter, as useful in some cases of irregular circulation, with gastric irritation.

I have frequently tried the influence of strychnine in cases of amaurosis, which I considered most appropriate for its use, but I have been very greatly disappointed in its effects; I have not seen one single instance of benefit from its employment in the manner generally recommended. I have, indeed, tried it in various ways, externally and internally, and have continued it till the involuntary muscular contractions have been frightful, but without advantage to the amaurosis.

There are many cases in which the power of the retina is slowly restored, when the cause of the amaurosis has been subdued; as after concussion of the globe, after cerebral disease, or pressure on the optic nerve, the recovery is promoted, in such instances, by stimulants, as electricity, galvanism, ammoniacal vapours, blisters, &c.; probably strychnine might aid equally, but I am satisfied that its effects have been greatly overrated, and that serious mischief has resulted from its indiscriminate use.

A fair and careful employment of the veratria has brought me to similar conclusions respecting its efficacy.

The use of stimulating vapours, lotions, ointments, drops, &c. to the eyes, or the employment of pungent and irritating snuffs, may relieve a little by creating a discharge, in some cases of organic or congestive ocular amaurosis; but they do not, as far as I have seen, produce so good an effect as a small blister to the brow. Electricity, galvanism, magnetism, &c. which I tried extensively, are feeble aids in relieving amaurotic diseases; I have rarely seen more benefit than some trifling acceleration of recovery from their employment.

The older writers on the subject of amaurosis are, for the most part, very confused, and the vagueness of their opinions of the disease is evident from the terms they have applied to it; they appear to have considered it altogether local.

By degrees, however, more careful observation proved the connection of these diseases with general constitutional disturbance, or with irritation or disorder in some other important organ, as the stomach, &c.; hence have arisen the divisions into the plethoric, that from debility, the sympathetic, the symptomatic, &c., as employed by Richter, and others.

More modern authors have continued to use these terms, and have added others, but in their arrangement of the subject, its divisions, and subdivisions, no two hardly agree: perhaps no better proof could be advanced of the difficulty and imperfection of the subject.

More has been elicited during the last half-century respecting ophthalmic diseases generally, than during centuries preceding, from the circumstance of their having been investigated on scientific principles; we are especially indebted to our professional brethren in Germany for their labours in this department, which have excited a similar spirit here and elsewhere, and which cannot fail to be highly advantageous to this branch of medicine.

In my humble opinion, however, our foreign friends have, in some respects, rather increased the difficulties of this and other subjects, by the numerous minute divisions they have instituted. It is certainly important in forming our diagnosis and plan of treatment, that we should be acquainted, not only with the direct, but also, in many cases, with the remote cause of the disease, as it now and then occasions some peculiarity in the case, and modification of treatment. When we find, however, that many various causes create a similar morbid action, which requires a uniform plan of treatment, I conceive that no practical good can result from a separation or division of such cases—but the contrary. I allude to the divisions, or rather subdivisions of Beer, Jüngken, and other German authors, and which have been adopted, in many instances, by some English writers on the subject; and in which several causes that create similar morbid action, and produce amaurosis of like character, are treated of as distinct or separate diseases: for example, suppression of secretion or discharge, or of cutaneous eruption, may, and often does, produce great disturbance in the circulation, with irregular determination of blood, from which some one part or organ more especially suffers,—it may be an abdominal or thoracic viscus, or it may be the brain or the eye, and in either of the latter instances an amaurosis may be produced; but the local disease presents no particular symptoms, or is not specially modified by the remote cause; it has the same character, whether it be the result of suppressed perspiration, suppressed lactation, suppressed catamenia, suppressed diarrhœa, suppressed hæmorrhoidal discharge, suppressed suppuration, suppressed cutaneous disease, &c. &c. The direct or immediate cause of the amaurosis is the same in all, viz., a morbid action existing in the brain, or in the eye itself: there ought not then, in my opinion, to be any division of such cases.

In my observations upon this subject generally, I have remarked the following circumstances, some of which have been previously noted by others.

That amaurosis from organic disease, without violence, of the retina, generally attacks the eye with dark-coloured iris; that it affects females more frequently than males; that it seldom confines its ravages to one eye; that it occurs in elderly persons, and that there is often hereditary disposition to it.

That amaurosis from disease in the choroid coat occurs most frequently in persons with light-coloured irides, of feeble power, especially in those of scrofulous diathesis, and that it appears during the early period of life.

That all occupations which require continued application of vision to minute objects, and especially such as are altogether sedentary, tend to promote congestive and organic amaurosis.

That I have never been able to trace the disease to the influence of stimulating or irritating vapour or gas on the organ.

That I have seen a congestive form of the disease of metastatic character in gouty and rheumatic persons, but it is extremely rare.

It will, doubtless, be remarked during the perusal of this paper, that I have not referred to any other opinions. I have purposely avoided it, considering that a full acknowledgment in this place of my having derived much valuable information from the works of the authors I shall name would be sufficient; honesty and justice compel me also to offer my warmest thanks to Dr. Farre, for his liberality and kindness in freely giving me, at all times, the result of his extensive experience, and his close observation, during nearly twenty years in which we have been colleagues.

Of feigned blindness.—Amaurosis is a disease which is very often feigned, and much difficulty occurs in some cases in detecting the attempt at imposition. In all these cases both eyes are said to be affected, though perhaps one is described as most defective, for the purpose intended by the feigner would rarely be answered unless all useful vision were supposed to be lost. Further the eyes have generally a perfectly healthy character in appearance, in action of irides, and in feel of the globes, unless the party be acquainted with the effect of belladonna, or some other of the narcotics which produce a similar effect, and has employed some previously to produce a dilatation of the pupils; this much increases the difficulty of detecting the imposture.

The classes of persons who feign in this way are children, and apprentices to get relief from tasks or work, or the latter to get free from an employment they dislike; soldiers and sailors to obtain remission of duty; members of benefit clubs or societies, in which liberal assistance is afforded to sick members. Now and then I see a case in which I cannot detect any reason for the attempt to impose.

I shall first detail the most marked differences between these cases and cases of actual disease, and afterwards the modes of detecting the feigned disease.

Unless the belladonna or some other preparation, which produces like effect upon the iris, has been applied, the eyes of the impostor present their ordinary and healthy characters, but there is usually some degree of assumed vacancy, and occasionally this symptom is well imitated.

In what cases of amaurosis does the eye preserve a healthy character and the iris a free motion? In some cases of congenital disease, and in the cat's eye of Beer, in which the morbid appearance is very difficult to detect without a previous knowledge of its existence; but with this, and with a dilated pupil, and modified light, it can be seen at pleasure.

The history of the case and careful examination would readily decide on either of these points.

In amaurosis from cerebral disease we have occasionally an active iris, but very rarely so; generally the pupils are more or less dilated, or one is so, or some degree of strabismus exists. I have never seen a perfect case of amaurosis from the cause mentioned, without some loss of power in one or both irides: here again the history and progress of the case will usually elicit the true disease.

All the other forms of amaurosis, when perfect, are attended with some organic change, or interruption of function in the iris or appendages of the eye, which cannot be feigned, and are not therefore likely to be mistaken.

The detection of the assumed disease may very often be made in getting the history of the case, provided the patient be allowed to tell his own story (which I consider best in all cases at first), for he is rarely sufficiently conversant with the ordinary symptoms to make a correct case; he will probably describe symptoms which are incompatible with each other, or such as could not exist without other evidence, or some material errors may be detected by the well-informed medical man; at all events by this means we gain much to lull or increase our suspicions. After this, an accurate examination should be made of the eyes, without and with the aid of belladonna to dilate the pupils; for unless the disease has been of long standing, or the belladonna, or other matter producing the same effect, has been previously used, the pupils will dilate, from the use of belladonna, further than apparent when first examined: this may then enable the medical man to judge whether the pupils have been acted upon by medical means or not, to aid imposition.

During the explanation of the patient, and the examination of the eyes, do not, if possible, excite his suspicions of your opinion of any attempt at imposition, but rather endeavour to obtain his confidence by a little well-timed pity, and agreement with his account,—you may thus often disarm him; whilst otherwise, by creating suspicions, you alarm him, and he is constantly on his guard. If he be unprepared, the sudden approach of the finger, or any extraneous matter to the eye will cause a sudden blinking, if there be not amaurosis; or you may observe that his eyes regard any one you may address quickly; or, if you attract his attention mentally, he will perhaps unintentionally be induced to direct and fix his eyes upon your countenance, as a person in earnest conversation usually does.

When suspicion is excited, or when the party is well upon his guard, it is sometimes very difficult to prove the existence of visual power; but I have seldom failed to do this satisfactorily by perseverance.

I have succeeded immediately by the following means:—During conversation dropping some small object, as a knife or pencil suddenly, which has been immediately picked up by the patient—pretending to see something in the room, or out of the window (if near) of curious or unusual character, the patient has been unguarded for a moment, and his eyes have followed the direction I have pointed to; asking how the patient's dress became torn or dirtied, his eyes have immediately been directed to the part mentioned or pointed to, and several other like expedients. In one case, of a little girl, which baffled me for two or three weeks, during which period she had been strictly watched but nothing elicited, I was engaged in conversation with her about her medicines, which she had much abhorrence of, and after trying to persuade her to take them well, I said I would give her sixpence if she would promise to do so, she assented, and I held out a halfpenny towards her, which she directly said (without touching it) was not a sixpence: she had previously sat for hours together without moving, and would allow me to place my finger or other matter in contact with the cornea without flinching. Children generally sham blindness badly, and can be pretty easily detected, by keeping them on short allowance for a few days, and then placing some tempting food in the room with them, and leaving them for a little time alone; and this plan often succeeds with adults—few persevere for any length of time in feigning total blindness, as they cannot bear the restraint it imposes upon them.

An imperfect amaurosis is sometimes pretended which requires much judgment to decide upon; the history of the case and the integrity of the organs are the best tests to guide the professional man.

I recommend the attentive perusal of the following authors to the student in this division of ophthalmic medicine:—

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(*Frederick Tyrrell.*)

AMBE, (from *ἄμβη*, the summit, or projecting point of a rock,) an instrument now obsolete. It was invented, it is said, by Hippocrates, for the reduction of luxation of the head of the humerus. It is described and represented in Scultetus's *Arment. Chir.*

It was composed of two pieces of wood, united by a hinge, the one rising vertically from a pedestal, the other extending horizontally from their point of union: the latter, which is excavated for the purpose, receives the luxated limb, and straps are used to secure it in this situation. The angle formed by the junction of the two pieces rests in the axilla. By pressing on the horizontal branch, extension is made, while the upper part of it helps to press the head of the humerus into the articular cavity. The inconvenience of this antique machine is, that it does not fix the scapula, and that it presses upon the head of the bone before the extension is sufficient to insure its easy return into the glenoid cavity.

(*Wm. B. Costello.*)

AMBLYOPIA. (See AMAUROSIS.)

AMBULANCE, from *ambulare*, to move about; denomination given by the French to an establishment in their armies formed for the purpose of affording prompt and efficient means to relieve the sick and wounded in the field. While every branch of the British service is remarkable for superiority of discipline and equipments, it has been a matter of surprise that no attention has ever been paid to the formation of an hospital corps. This neglect was sadly felt during the late war. The talents and personal efforts of medical officers are of little avail if they have not proper and sufficient assistance, afforded on the exigencies of the moment in the hurry and tumult of war, but previously formed and organized upon a systematic and liberal plan. Above all things it is necessary that this assistance should be independent of the ranks of the army, which are too much thinned by the casualties of the service.

A steady non-commissioned officer and well disciplined soldier are too valuable to be detached from their regiments, and commanding officers very naturally will endeavour, on such occasions, to get rid of the worthless; hence are orderlies, generally speaking, the worst description of soldiers. Every duty connected with the service of the sick or wounded should be performed by men trained for this special duty under the military command of their respective officers, but placed at the disposal of the medical department.

Such a corps must be considered in two points of view: 1st, as regards the *persons* of whom it is composed; 2nd, as regards the *objects* with which it should be supplied: the former arranged into field companies, with a view to the services they have to perform; the latter affording means of transport for the wounded, carriage for the necessary field stores and surgical equipments. A field company ought to be attached to every division of the army, and subdivided according to the brigades of each division of various arms, each company to be in the proportion of 20 rank and file to 1000 men; bearers on the most approved plan to be provided in the proportion of one to every 100 privates. The means of transport necessary for the corps should consist of two improved light spring waggons for each brigade; and one long car capable of bearing off eighteen wounded men, nine on each side, to each regiment. Thus a division of 10,000 men, divided into four brigades and about fifteen battalions, would take the field with eight spring waggons, fifteen long cars, and 100 bearers. When unemployed in the field, these cars might prove highly serviceable for the transport of the light bedding of each regiment, consisting of twelve palliasses and bolster cases, twenty-four pair of sheets weighing 96lb., to which might be added twelve rugs weighing 88lb. In addition to this conveyance, two light store waggons should be attached to each division, their body divided into compartments, and covered with a tarpauling. These cars should carry the following indispensable articles for the establishment of field hospitals, when most probably the theatre of war cannot afford the necessary means. Four bell-tents, two large camp-kettles, two large tea-kettles, twenty-four tin cans in series, a triangle for suspending kettles, two leather water buckets, two light stretchers for operations, two light folding stools for ditto, forty-eight palliasse cases, forty-eight sheets, forty-eight spare blankets, one set of butchers' knives and cleavers, four bill-hooks, two spades and girdles, two felling axes, two light hand-saws, four lanthorns, four lamps, packing thread and needles, pins and tape, cord and twine, lint, tow, linen bandages, compresses, rollers, sponges, splints, arm-slings, oil cloths, wax-candles, torches, cotton wicks, with a small supply of groceries, brandy, and wine. Linen for dressings or lint should be furnished abundantly to every ambulance; and in order that it may occupy but little space, it should be chosen fine, and packed into cases made for the purpose. When kept in large quantities, excluded from light or air, it is liable to become mildewed. Lint or linen thus damaged, may often be productive of bad effects on the wounds to which they are applied as dressings; and even give rise, under unfavourable circumstances, to hospital gangrene. Should the quantity fail, tow may be used in its stead; when cut into proper lengths, bleached in a chloruret, and properly carded, M. Gama, who first used it, states that it answers the purpose perfectly; but charpie should not be used at all, as it may have been prepared from foul linen, and as it contracts hurtful alteration much more readily than lint. All portable articles to be packed up in small bales, cags, or packages duly labelled, that in roads impracticable for wheel carriages, they may be carried on *bât* horses or mules. These articles should occupy as little space as possible. One of the great objects to be held in view is the facility and celerity of transport; the economy of space and weight therefore is matter of importance. There should also be a supply of liquid acetate of lead, and of the watery solution of opium; the former for ready application with water to contusions, sprains, and profound lacerations, in which the skin remains whole; the latter, to wet the dressings in cases of torn wounds, burns, &c., produced by explosions of shells, the bursting of guns, &c. Wax candles are indispensable, as without them no efficient succour can be given to the wounded on the field after night has fallen; no operation performed; and thus too often, would the bleeding soldier be exposed to perish from wounds which care and timely attention would heal.

The foregoing is the divisional detail of transport, but a reserve park of spring waggons, and long cars in the proportion of two of the former by division, and one of the latter by brigade, should move in the rear of head-quarters for the purpose of replacing deficiencies, and further assisting in the evacuation of field hospitals.

Although the hospital corps is chiefly intended for the service of the wounded in the field, yet it is to be employed in the hospitals of the army when in quarters. In which case, orderlies detached from their regiments would rejoin their respective corps, where they would again reap the benefit of regimental discipline, and lose those unsoldier-like and slovenly habits that such men are liable to contract when away from their officers. The French organization of their *ambulance* companies might serve as a model for their formation. It is as follows:—one captain, one subaltern, one sergeant-major, one pay-sergeant, five sergeants, or upper ward masters when in hospital, ten corporals or under ward masters, two bugles (indispensable for sounding halts and advance in the transport of wounded), ninety-six privates or orderlies, one tailor, one shoe maker, one cutler (a most useful artisan to keep surgical instruments in repair), one carpenter, four cooks; when employed in hospital, these are distributed in the proportion of one ward master for every hundred patients, and one orderly to every twelve. The waggons and cars, with their drivers, will be also under the command of their proper officers; non-commissioned officers, with wheelwright, farriers, saddlers, &c. &c., are also to be attached to the corps.

Duties upon a march.—Troops usually move by divisions and by brigades. Previously to their marching, the *ambulance* and hospital corps should be formed on the assembly ground, and all men unable to proceed with their corps should be brought to this spot by one of the regimental medical officers, who will leave with the medical staff officers attached to the ambulance a return of cases. The regimental cars to move in the rear of their brigades, when not otherwise ordered by the general officer in command. These cars to receive and carry the packs of weak men not requiring transport. The hospital corps and the spring waggons to move at some distance in the rear of the division, picking up and carrying such men as had not been able to proceed with their companies. When troops arrive at a wholesome source of water, the hospital corps should fill their canteens for the use of the sick. When the troops are bivouacked, the hospital corps should be employed in throwing up huts, or in establishing temporary hospitals in any adjoining buildings, and in preparing some light food for the sick they have brought in. As the independence of this body is indispensable, a commissariat should be specially attached to it, to issue the necessary supplies, both to the corps, and the sick and wounded under their care. When troops are marching near the enemy, the spring and store waggons should move at some distance in the rear: the long cars, with the hospital corps and their bearers, should keep close in the rear of their respective brigades, to afford immediate relief when necessary.

Every regiment is allowed a bât horse or mule to carry medicines, materials, and instruments. The panniers hitherto used for this purpose are, in every respect, most objectionable. They are made of osier work, and are unwieldy, liable to be bulged in when coming in contact with other baggage, easily penetrated by rain, or injured in fording deep rivers or streams, the covering skins not protecting sufficiently the pervious baskets—they are also much too large: a very small proportion of medicine is requisite in the field, and these cases should, therefore, principally contain surgical materials. Light leather waterproof cases are preferable, as they can be slung on an orderly's back, when rapid movements off the roads prevent bât horses from keeping up; they should besides be made to open in such a manner as to bring their contents into view, to obviate the necessity of unpacking and deranging. It would be desirable that surgical saddles, on the plan of those proposed by M. Weiss, should be adopted by regimental surgeons, as they contain all the instruments, materials, and medicines, that could possibly be required in the field, by which means bât horses might be kept in the rear, and not encumber the line of march, an evil that should be guarded against, as much as possible, in military operations.

In addition to these, the assistant surgeons should carry a small leather haversack, with a cover buttoning down to contain their pocket instruments, several pairs of locking or torsion forceps, a few light dressings, pins, sponges, &c. &c. The hospital sergeant should be equipped with a larger leathern haversack for additional dressings, sponges, tourniquets, wax candles, and the means of striking a light. Incalculable difficulties and serious accidents are frequently encountered from neglect in carrying wax candles and lanthorns. This extensive distribution in small quantities of surgical materials and medicines will greatly tend to diminish transport, and render them more available in the assistance of the sick and wounded. Nothing can surpass the distress a surgeon experiences in action, when the bât horses have been delayed in the rear; medical officers should therefore be independent of this casualty, and always have with them dressings for at least 100 or 150 cases; the lint, rollers, and adhesive plaster required for that number would be of very trifling weight when thus divided. It will appear by this arrangement that the portable material will be in the first line, the light carriages in the second, and the heavier conveyances in reserve. In surgical equipments great attention should be paid to the fracture splints, which should be of sufficient solidity to protect the limb from the jolting which the wounded must more or less experience on bad roads. Stump pillows, made of the patent India rubber, to be inflated when required, should also be provided, as they will be found of the greatest utility and comfort in cases of amputation. Every experienced surgeon must have frequently wished for such an invaluable aid when obliged to prop the sufferer's limb with stones, knapsacks, or any other support they can find at hand. The perfect manner in which this cloth is now prepared by the patentee, and the variety of uses for which it is daily made available, recommend it strongly for many important applications in the field, such as tents, beds, pillows, seats, over-all coats, water skins, &c.; but the screw-stopper, for inflating the beds, pillows, and seats, should be of a simpler and better construction than that in present use.

Duties of Medical Officers and the Ambulance or Hospital Corps in action.—If zeal, talent, and industry are requisite qualities of a medical man in camps and quarters, it is more especially when contending armies meet that all his energies should be collected. While warlike preparations occupy the military leaders, the army-surgeon, calm amidst the surrounding storm, must be ready to meet with fortitude and deliberation the contingencies of war, and assist with promptitude and with vigour the victims of the conflict. He cannot at this anxious moment expect that military chiefs can bestow a thought upon his duties, or regulate his arrangements; he alone stands answerable to his country, that her wounded soldiers are assisted with diligence and attended with care. Medical assistance in battle should be divided into three lines; 1. In the rear of each brigade and within range of musketry, but protected as far as possible by any favourable feature of the country, or buildings, there should be stationed a portion of the hospital corps with the bearers and their canteens filled with water. These men should be placed under the direction of a regimental assistant-surgeon, who will not delay the wounded, but merely apply indispensable dressings and accelerate their speedy removal to the second line. For this purpose the bearers should form a chain of posts along the entire rear of the line, and according to the proposed distribution, a brigade of three thousand men would be assisted by sixty men of the corps with thirty bearers; each post of the chain should then consist of ten men and a corporal; the spare drummers and pioneers would lend additional aid, and on no account whatever should drummers, musicians, or others, non-combatants, be left in charge of their officers' horses; proper bât-men, or servants, should be attached for that service. In the second line, out of range of musketry, should be established the brigade field-hospital, distinguished by a large camp colour. Here should be found the regimental surgeons, with their assistants, together with the spring-waggons and cars; at this post the wounded must be dressed, cases requiring immediate operations attended to, the wounded placed upon the spring-waggons, or cars, and hence, the bearers, having deposited the wounded, should be sent back to the first line.

In the rear of the centre of each division will be formed the divisional field-hospital, which, if possible, should be out of the range of artillery; this post should be attended by the staff-surgeons of brigades and their assistants, and here operations will be performed, and the wounded assembled to be sent still further to the rear, by the reserve conveyance, or such additional means of transport as the commissariat of the army may procure; for the spring-waggons and cars belonging to the ambulance should immediately return to the second line of assistance. At this third or divisional post the store-waggons will be unloaded, tents pitched if necessary, the folding stretchers for operation put up, and weak broth and spirits and water prepared for the wounded.

The principal medical officer in the field, with the commanding officer of the hospital corps, should be held responsible for the regularity of the service in these three lines of assistance,—replacing from the second line to the first and from the third to the second any casualties amongst the medical officers that may occur during the action. In the establishment of field-hospitals the quartermaster-general should be consulted, that they may not be formed on points likely to be drawn into the circle of operation. The strictest orders should be given to prevent medical officers of regiments from proceeding to the rear with their commanding officers when wounded, an abuse which has too frequently prevailed. While these arrangements are made in the field, evacuating hospitals should be formed in the towns or villages in the rear of the army, where the wounded can be accommodated, and where bedding may be procured from the inhabitants, and means of transport impressed. When the army advances, the first and second lines of medical assistance should also move forwards. On the other hand, when a retreat is commanded, the first and second lines should fall back on the rear, but without precipitation or confusion. If a sudden occurrence should force the troops to abandon their position, the medical officers of the first and second line, with the hospital corps, should immediately fall back on the third or divisional hospital, where no great accumulation of wounded should be found, as from the very commencement of the action, precautions had been taken that the wounded should gradually, but rapidly be sent to the rear. How desirable it would be in these moments of unavoidable confusion, that the surgeons of European armies should wear a distinguishing mark for their protection,—a plume, or aigrette of black horse-hair, which could be worn in all weathers, would be the most easily recognised, and by mutual accord respected.

A victorious army either moves on to further operations or halts upon the field of battle. In the first case, regimental surgeons should proceed with their corps, and the brigade medical staff follow, when the wounded are sent to the rear, the third line would be reinforced with surgeons from the general medical staff. When our troops remain upon the field, and the enemy have fallen back, the medical officers of the second post should proceed to the front of the line of battle with spring-waggons and cars to collect the wounded that may have been left by the skirmishers. As this operation would most probably be conducted during the night, a few torches should be carried by the hospital corps, to facilitate this important and humane search, which is too frequently neglected. Should the fortune of war have compelled us to retreat, the third line should dispatch to the rear every case for which they can find transport, lest any of the waggons should fall into the enemy's hands; all the cases that cannot be removed should then be collected in houses, or if none are on the spot, in fields off the high road, that they may not be exposed to the ill usage of the light troops of the enemy sent in pursuit. The spot where the wounded are thus collected should be distinguished by a large black flag, and a staff-surgeon, with sufficient assistants, left with them.

In future wars it is to be hoped that feelings of humanity will induce belligerent powers not to consider army-surgeons left with the wounded as prisoners. On these painful occasions, sufficient dressings should be also left, as we cannot depend upon the medical stores of the enemy, which may be exhausted, or of an inferior quality. When surgeons are thus placed on duty with an enemy, they must bear in mind that the welfare of our wounded will in a great degree depend upon the propriety of their conduct. No irritation of mind from disappointment, no national feeling should induce them to enter into unpleasant discussions. They should especially endeavour to cultivate a friendly intercourse with their medical brethren, carefully avoiding altercations on professional points, in which most probably they may differ. A deviation from this prudential course has often proved the source of jealousies and animosities, from which the wounded ultimately suffered. When the enemy's wounded are numerous, and their surgeons are not in sufficient numbers to attend to them, we should invariably volunteer our assistance should our own duties afford us leisure. Such a line of conduct is ever appreciated, and cannot fail to lead to ultimate reciprocal advantages and good feeling.

Napoleon, in the North of Spain, having accidentally seen one of our assistants[1], dressing some of his wounded, immediately ordered one hundred Napoleons to be sent to him, with a passport to proceed to Paris, accompanied with a letter recommending him to the minister of war, whom he directed to give him a free admission to the hospitals and schools of the French capital.

In cases where the wounded of the enemy fall into our hands, we should be careful to keep them as much as possible separate from our own, and surgeons understanding their language should be preferred in the selection of their medical attendants. These wounded men should be collected on a given spot, made known to the enemy by a flag of truce, that they may send conveyance for them, and thus relieve our own means of transport, seldom sufficient for all casualties. In night attacks the difficulty of collecting and attending the wounded is incredible, as in these operations, which are usually *coups de main*, the darkest nights are selected. Fires to point out the stations of the surgeons would be desirable, were they not incompatible with military prudence. Torches and lanthorns should, therefore, be put up at every medical point to direct the bearers. The position once carried, fires may then be kindled wherever the wounded are assembled. By the foregoing distribution of medical men and the hospital corps, allowing to each regimental and staff-surgeon two assistants, an army of thirty thousand, which we shall suppose formed of six divisions, twelve brigades, and forty batallions, would be attended, in the first line of succour, by twelve assistants and three hundred bearers; forty surgeons, and sixty-eight

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[1] The late surgeon Brown of the 50th regiment. The emperor would not liberate him, on the plea that we had been the first to consider army-surgeons as prisoners of war.

assistants with twenty-four spring-waggons and forty long cars on the second line; and by twelve staff-surgeons and twenty-four assistants on the third.

The expense of such a corps might be adduced as an objection to its formation, but it would not cost the state more than a battalion of eight hundred men and a squadron of one hundred and fifty horse; and when we reflect on the invaluable services they would render our suffering soldiers, distant from friends and home, and exposed to the accumulated miseries of war, the strictest economist would cheerfully sanction a much greater expenditure; nor is there a commanding officer in the service who would not hail with satisfaction such an establishment, as it would obviate the necessity of constantly thinning his ranks by detaching orderlies.

Transport of Sick and Wounded.—If the hospital corps could prove of such essential service in the field, in the transport of the sick and wounded to the rear, their assistance would again present incalculable advantages. On this duty they would not only act as orderlies to attend their charge, but would serve as an escort to the convoy; since every private of the corps would be armed with a light carbine.

For the purpose of moving the sick and wounded of an army, we have three means of transport;—1. The conveyance belonging to the hospital corps; 2. The transport of the commissariat, rendered disposable by consumption; 3. Transport belonging to the inhabitants, and impressed for the service. We can only depend upon the first mode of conveyance, but every exertion should be made to obtain the other means of transport.

Officers of the commissariat should invariably be directed to give timely information to the principal medical officers of corps of the time of the departure of their return-transports to the rear for supplies; by this means regiments would gradually be disencumbered of their chronic cases, which by accumulation would materially impede the service, when operations in the front commence. These conveyances should be divided into classes. For instance, waggons, wains, or cars, &c., drawn by horses, mules, or oxen; the number of men each can carry; horses, mules, dromedaries, asses, &c., according to the greater ease and comfort these several descriptions of conveyance may afford: the sick and wounded should be selected and classed.

When water carriage can be found, it should be ascertained whether the boats are decked or open, or capable of being protected by an awning, that the sick may be embarked according to the nature of their ailments. When the sick and wounded are evacuated on the rear, to facilitate these operations, chains of communication should be established between the army and the general hospitals that are to receive them: each station or halting-place to be provided with a small detachment of the hospital corps, with a few spring-waggons and cars, assisted by the occasional passage of disposable commissariat transports, by which means the army would be imperceptibly relieved of their encumbrance without trespassing heavily on the other means of transport. When the inhabitants have fled from their dwellings, which most probably will be found plundered, a small supply of hospital equipments should be issued at every halting-place; but care should be taken that the sick and wounded soldier leaves his corps with his blanket, great-coat, canteen, &c. At every halt a *rendezvous* should be fixed upon for the transport and the sick to assemble the following morning. But when the sick are scattered about a large town, in distant quarters, as every individual concerned cannot exactly know the hour, if there is artillery in the place a gun should be fired half an hour before the time of departure, that the hospital corps, drivers, guides, &c. may repair in time to the assembly-ground.

When transport is impressed, it would be desirable, when practicable, that each communicating station should have a relief of conveyance, by which means the peasantry could return to their homes. When this unfortunately cannot be the case, the peasants will very frequently steal away their cattle during the night. Under such circumstances, the local authorities should be required to replace instantly the draught-horses or oxen withdrawn; this will induce the people of every village to assist in watching the impressed cattle of their neighbours. It is impossible to impress too deeply upon the minds of all those who are in charge of convoys of sick and wounded, the absolute necessity of treating with kindness and humanity the unfortunate peasantry torn from their home and agricultural pursuits for the transport of our sick; when possible, the drivers should be paid at the end of every journey; at all events, their services should be remunerated at a reasonable distance from their abodes, and not by cheques on distant chests, which only become objects of a most disgraceful speculation, as their holder, unable to travel several hundred miles for his wages, will sell his orders, at a sad discount, to the vampyres who follow armies. When the days are short, the hospital corps should be provided with torches. Straggling on the line of march should be carefully avoided, and the head of the convoy should be halted to bring up the rear, when from any circumstances the continuity of the column has been broken up. Wheel conveyance should invariably move in the rear, and the slowest transport lead.

During a Siege the hospital corps and ambulance is also of great service; a certain proportion of men with their bearers should be stationed on such points of the parallels as the engineers may consider the safest from the fire of the town. Appointing medical officers to the trenches is a useless precaution. All the casualties should be transported by hand to a sheltered point, where the field-hospitals are established.

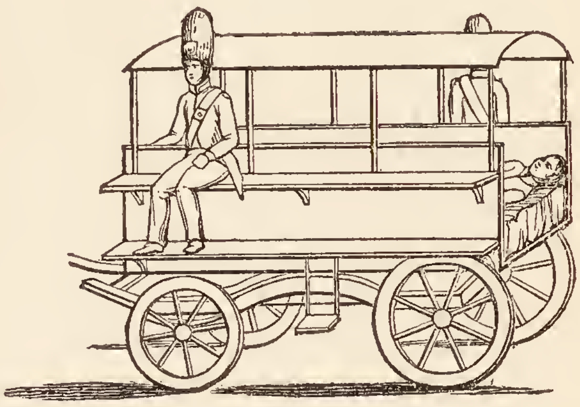
This spot should be distinguished by a black flag for its protection, as pointing out a neutral ground consecrated to the general cause of humanity; this signal should invariably be respected by besieged and besiegers, and in no instance should works be carried on under its protection, or ammunition secured. The flag should be struck the moment the ground becomes a military post. All storming or escalading parties will be followed by a sufficient number of surgeons and bearers, with torches and lanthorns to be lighted when required. When the besieged fortress is carried by storm, the wounded in the breach may be hoisted on the ramparts in cots slung from beams projecting from the parapet. This will be found more expeditious and less distressing than carrying them back over the counterscarp, to go round by the town gates.

In a besieged town.—Here the spring-waggons and cars are useless, and their horses only increase the consumption of forage. The wounded should be carried away by the hospital corps in carriages belonging to the town, or on bearers; the sick and wounded should be accommodated in public buildings, on which a black flag is to be planted, in a situation easily discerned by the besiegers during the day, and reflecting lanthorns will designate it in the night. During a bombardment, the wounded had better be secured in bomb-proof casemates, and medical officers should be on permanent duty both day and night, and detachments of the hospital corps stationed at every point of attack, whether in the outworks, or in the fortifications of the body of the place.

When a breach is rendered practicable, the surgeons of the garrison, with the hospital corps, should assemble in the vicinity, in some safe building. Should the storming party be repulsed, the wounded left in the ditch and on the breach should be removed over the ruins by means of planks fixed on a gang-board, and laid down as a platform; a truck moving upon four low wheels, in grooves, and lowered by a windlass, will be found most convenient for this humane purpose. In night-attacks it would be desirable that, by a mutual agreement, signals by rockets, for a short cessation of hostilities should be thrown up, that the wounded might be collected and borne away: their situation after an assault is truly deplorable,—heaped up with the dead, amongst ruins, most probably wet through from wading across the fossé, and generally very severely wounded; the delay of a few minutes is to these unfortunate men of vital importance. It is needless to add, that the *matériel* of the ambulance or hospital corps must vary in description according to the features of the theatre of war. In mountainous tracts, our waggons and cars will be useless, but wherever field-pieces and the pontoon train can move, our wheeled transports can follow.

The same observation applies to our medical stores, which must be more or less abundant, according to the state of the country. In populous and fertile provinces, local supplies may be provided, but in an abandoned and impoverished land it must be obvious that all the wants of the wounded that are not previously foreseen, will be sadly felt in the hour of need; and while we should not encumber ourselves with useless medicines, we should not dread even a superabundance in our surgical means of relief.

Fig. 8.



Model of a light spring-waggon for bearing the badly wounded off the field. Those slightly wounded are placed on seats each side of the waggon.

(*J. G. Millingen.*)

AMENORRHŒA (from *α*, priv., *μὴν*, a month, and *ῥέω*, I flow,) has usually been considered under two heads, *emansio* or retention, and suppression of the menstrual secretion; the former implying its non-appearance at the usual period of life, the latter, its interruption after it has become established.

In viewing the important function of menstruation physiologically, we are struck with many of its phenomena at once peculiar and interesting, and among others, those which may be considered concomitants, or rather precursors of its first appearance. From an early period in the history of medicine up to the present time, writers on physiology have observed, that in warm countries, as in some parts of Asia and America, puberty in the female occurs as early as the ninth or tenth year, whilst in the colder regions, as in Lapland, it may be retarded to the eighteenth or twentieth year. In this temperate climate the uterus begins to perform the function of menstruation when the female arrives at the age of fourteen or fifteen. It must not be overlooked, that the first irruption of the secretion does not depend on climate alone, but on a perfect development of the generative system. The uterus and ovaries must have assumed the characteristics of the adult, and a correspondent change must have taken place in other and distant organs. In a pathological or curative point of view this circumstance is of no ordinary moment.

In investigating the pathology of amenorrhœa, there are two conditions of the whole economy which demand careful consideration; one in which the system has morbidly arisen above the natural standard, the other, where it has sunk below it, and when with an appearance of general debility, there is often to be found local congestion, producing a torpidity of the uterine capillaries. The healthy and morbid conditions of the various functions of the body, but more particularly of the chylopoetic viscera, require careful observation, as the non-performance of the healthy action of the uterus after development may, for the most part, be traced to disturbance in the general health. It is true that constitutional derangement is sometimes the *consequence* of suppressed catamenia ; and the cause of retention may be found in the structural alteration of some part of the uterine system, as an imperfect formation or occlusion of the os uteri, cohesion of the labia, or vagina, or imperforate hymen. The menstrual fluid may have been duly secreted, and its escape prevented by one of the organic causes mentioned, but particularly the latter. In such a case, puberty will have become developed, but the patient is found with enlargement of the abdomen, besides various pelvic and abdominal symptoms, which taken altogether, frequently excite an unjust suspicion of pregnancy. The structural peculiarity in the hymen, can only be detected by examination, when a small crucial opening by means of a scalpel or lancet will allow the secreted fluid to escape, and afford an alleviation to the sufferings of the patient. In interrupted functions of the utero-vaginal system which do not yield to judicious treatment, a careful examination should be made by the touch. It is generally unfortunate for the female when from a too fastidious delicacy, whether on the part of the practitioner or patient, this inquiry is neglected. Again disease may exist in some distant organ or tissue, as, for instance, in the lungs, liver, &c., when the functions of the uterus will become interrupted, and can only be restored by the original cause being removed.

The female having gone beyond the period of life when the first appearance of the catamenia might have been anticipated, if a plethoric condition of the system obtains, it may be easily recognised. Headach, vertigo, or a sense of weight in the head, with occasional throbbing, flushing of the face, thirst, and a quick accelerated pulse, are the most prominent characteristics of a loaded circulation. This condition of the system may be protracted, but it is usually of short duration, and the general health sinks into the second state before alluded to, a state eventually productive of important functional and structural derangement. In this case the hue of health will have vanished from the cheek, pallor prevails, generally with a darkness about the eyes, and partial tumidity of the face ; and in what may be called the second stage, together with these appearances, a tinge of the icterode or yellowish green colour is so obvious in the countenance, that the term chlorosis or green sickness has been given to the disease. The tongue, at first white and loaded, becomes red, and not unfrequently, its papillæ enlarged. The appetite is singularly affected ; and it is common to find in the patient an unconquerable desire to eat lime, chalk, earth, sand, and other substances equally indigestible and improper ; in short, the digestion becomes imperfect, and a deteriorated condition of the blood with a loss of vital energy are the results. The patient is now almost incapable of exertion, she is subject to dyspnœa, with a short irritable cough, which, together with frequent accessions of pain in the chest, or sides, create in the minds of her parents or friends considerable apprehensions for her safety.

In promoting a healthy action of the uterine system, whether the case be one of retention or suppression, the condition of the circulation demands early attention ; and where there is an excess of action in the pulse, with headach, a furred tongue, hot skin, and other symptoms of undue excitement, the means required should be those usually included in the term antiphlogistic. It is comparatively easy to accomplish the first object in view, that of lowering the system—would it could be said to a standard of health. General bleeding, not objectionable as a powerful remedy in some cases, should be employed with caution ; but the local abstraction of blood, by means of leeches to the groins, or by cupping glasses applied over the sacrum, may be had recourse to, oftentimes with great advantage. These, together with active purgation, and a vegetable diet, may be the means of producing the wished for discharge.

Fortunately for the sex, pathological inquiry, with its results, has superseded bigotry and false principles ; and a revolution may be said to have taken place in the treatment of amenorrhœa. To the experienced physician, a restoration of the patient's general health is his primary object ; this accomplished, there is oftentimes little more to be done. These remarks are applicable to both retention and suppression. The latter may be classed under two heads, the acute and chronic. From exposure to cold, some violent mental or bodily exertion, or from some trivial accident a few days or hours before the menstrual period, the discharge does not appear as usual, or is suddenly arrested even after the period has commenced ; this may be called the acute obstruction, and will be attended by a quick pulse, pain in the region of the uterus, a sense of bearing down, thirst, headach, and other symptoms of pyrexia, and occasionally with some degree of hysteria. It may be requisite, under such circumstances as are here described, to have recourse to the lancet ; but in the abstraction of blood, we should be governed by the system of the patient, and the urgency of the symptoms. Local bleeding, under ordinary circumstances, will be preferable, as already suggested. Purgatives of an active kind should be given, and the hip-bath may be used with advantage. Should there be much pain in the region of the uterus, together with spasmodic or hysterical symptoms, camphor, combined with hyoscyamus or opium, will be useful. These measures, however judiciously employed, will not always prove successful in securing a return of the discharge.

In amenorrhœa, from interrupted functions in the various organs, and consequent decline of the general health, whether in the youthful or adult female, a plan of treatment of some continuation will become necessary, which plan may with propriety be classed under the following heads:

1. Mild and continued purgation. 2. Exercise in the air, as much as the patient can bear without fatigue. 3. The warm hip-bath or pediluvium. 4. A rigid system of dietetics. 5. Medicines which assist in promoting a healthy digestion. 6. Medicines which are supposed to possess the power of exciting the secreting vessels of the uterus.

1. The value of the Hamiltonian system of purgation will be almost universally admitted in amenorrhœa. Who has not oftentimes seen it produce the long-looked-for discharge, without an auxiliary remedy? Of the warm stimulating aperients which act on the lower part of the intestinal tube, probably aloes is the best, in the form of the compound decoction, or the aloetic pill in combination with rhubarb. Purgatives should be administered with great regularity, that the bowels may be acted upon freely, but not powerfully. The degree of debility in the digestive apparatus should be the principal guide in the choice of aperients, care being taken that too great a depression of the vital energies does not ensue from an excess of alvine discharges.

2. For the promotion of health in the various secretions, any of the active exercises in the open air when the atmosphere is dry and cool are highly important. Walking, moderate dancing, (not in hot rooms late at night,) horse-exercise, &c., gradually increased in frequency and force, without inducing much fatigue, should be practised with regularity, notwithstanding it may be necessary to enforce it against the inclinations of the patient, whose bodily and mental faculties will probably have become languid and inactive. If the system be greatly impaired, the passive exercises, as riding in a carriage, or sailing, should be substituted.

3. Twice or thrice in a week the warm hip-bath, at about 95°, for a quarter of an hour, should be used, after which, friction with a soft brush or flannel, will prove serviceable; indeed, when from circumstances the kind of exercises alluded to are unattainable, a valuable substitute for them will be found in general friction; it promotes a glow and perspiration, and tends greatly to increase the energy of the frame.

4. The diet should be light and nourishing, and the quantity moderate at each meal. Stimulating drinks are generally to be avoided, but in some cases a glass of good Madeira, sherry, or a little mild ale may be taken daily, provided it does not occasion headach, or preternatural activity in the circulation.

5. When the functions of the stomach are disordered, aromatic bitters will often prove of service, either alone or combined with steel. Probably one of the best forms in which steel can be administered, is the Mistura ferri composita. The cardialgic symptoms, if troublesome, may generally be removed by the liquor potassæ subcarbonatis. A course of chalybeate waters may be tried, their efficacy being aided by the society and amusements which, at public watering places, can be usually obtained.

6. In the medical treatment of amenorrhœa much confidence has been placed in the various stimulating medicines termed Emmenagogues, from their being thought capable of exciting the uterine vessels. In their exhibition care must be taken that the system be placed in a state fit to receive them. If the vital actions be too low, or on the other hand, if they be much excited, emmenagogues, always of doubtful utility, are inadmissible. Madder, savine, hellebore, guiacum, iodine, secale cornutum, strychnine, &c., have all in turn been extolled; they are, however, more calculated for suppression than retention of the catamenia.

In married females, or widows, the local remedy recommended by Lavagna may be tried; it must be considered, however, as secondary to general treatment. Ten or twelve drops of the aqua ammoniæ puræ in an ounce of milk and water, (or of sufficient strength to produce some degree of irritation) are to be thrown into the vagina twice or thrice a day.

Galvanism and electricity have been employed with success; and the tourniquet has been applied round the thighs for the purpose of causing a greater determination to the vessels of the uterus; the latter plan has met with but few advocates.

In amenorrhœa, blood is occasionally discharged from the nostrils, nipples, bowels, or sometimes from an ulcer, which seems intended as a substitute for the catamenial secretion to keep up the balance of the circulating fluids; this has been designated vicarious menstruation.

(*George Jewel.*)

AMMONIA, MURIATE of, *hydro-chlorate of ammonia, sal ammoniac*, syn. *muriat d'ammoniaque*, Fr.; *Salmiack*, Ger. The name *ammonia* is derived to this substance from the circumstance of its being formerly procured from Ammonia, a district of Egypt, in which was situated the temple of Jupiter Ammon. It used to be obtained by subliming the soot formed by burning camels' dung. As chemistry advanced, it was derived from other sources, and was commonly prepared by adding sulphuric acid to the volatile alkali obtained from soot, bones, and all the offal of large towns, mixing it with common salt, and subliming it. It is now obtained in great abundance, and at a very cheap rate, from the ammoniacal liquor resulting from the distillation of coal to form gas.

In the liquid state, ammonia is highly caustic, and produces powerful effects on the animal economy. When applied to the skin, it produces, according to its state of concentration, and the duration of its contact, a slight degree of rubefaction, or vesication by the extravasation of serum, under the epidermis, or the formation of an eschar; three of the stages of burns. The *pommade de Gondret*, which consists of equal parts of ammonia, and mutton suet, previously melted at a slow heat, possesses all these properties. Soon after it is applied, it produces redness of the skin, with pain and heat, and in fifteen or twenty minutes, the epiderm is raised into a blister, corresponding in extent to that of the application; if it be continued for sometime longer, an eschar is formed. In this preparation, therefore, the practitioner has a double resource,—first of a blister, in cases where the action of cantharides might be dreaded; secondly, of a moxa, for persons who dread that species of application too much. But whether alone, or in conjunction with unctuous substances, it deserves to take an important place amongst the stimulants of the skin; and is often employed as a resolutive in indolent engorgements, in chronic inflammation of the lymphatic ganglions, glands, and even of the fibrous and osseous tissues; and as a revulsive, in neuralgic and rheumatic pains. For the mode in which it is employed in these cases, see Paris's *Pharmacologia.*

As a caustic, it is advantageously employed in poisoned wounds, as it decomposes the venom, and destroys, at the same time, the parts in which it had been deposited. When the patient refuses excision, or when excision is impossible, after the bite of a serpent, or rabid dog, it may deserve consideration, whether the liquid ammonia should not be preferred to the iron, at a red or white heat.

One of the great advantages to be held in view, as regards this substance, is the power it gives the surgeon of varying the intensity of its effects according to the object he has in view; thus, when he is afraid of inflammation, he may expose the parts for a few moments to the vapours of the ammonia; in acting on an amaurotic eye, for instance. In liniments of various kinds, its effects are moderated by its combination with oils, in the proportion of a drachm or two of the ammonia to an ounce of oil; thus conjoined, it forms a liquid soap, with which frictions are made on the skin for various indications. M. Larrey, who frequently employs the incandescent iron in his hospital practice, often pours liquid ammonia on the eschar, with a view to lessen the pain produced by the application of the heated iron.

Lavagna has recommended it in the form of an injection into the vagina, in amenorrhœa. For this purpose, he mixed ten or twelve drops of the ammoniacal liquor, with an ounce of warm milk. The injection is used three or four times in the day. He has often succeeded in this manner in bringing on the catamenia, in the space of one, two, and at furthest in five or six days. The practice, however, is not resorted to, by English obstetricians. It has also been found beneficial in cases of simple leucorrhœa.

AMMONIAC, *ammoniaci gummi*, L. *ἀμμονιακὸν*, Gr., *Ammoniak*, Ger., *gum ammoniac*, Eng. The derivation is the same as that of the preceding term. The ammoniac is a gum resin, obtained by the hardening of the milky juice that flows from the *heracleum gummiferum*, a plant which grows in the sandy plains in the interior of Morocco. By more recent writers, however, especially M. Fontanier, who saw the plant growing at Yezd-Cast, in Persia, it is said to be derived from some of the species of *Ferula*, and is called by Lemery, *ammonifera.*

Its use in external application is now much restricted, but it has enjoyed great reputation as a discutient in scrofulous and indolent tumours, particularly in the vicinity of the joints. Combined with mercury it forms the *emplastrum hydrargyri cum ammoniaco.* When dissolved in vinegar, and evaporated to a proper consistence, as in the *emplastrum ammoniaci*, it is sufficiently stimulant to produce an inflammation, and papular eruption of the skin.

AMPULLA, Lat.; *ampoule*, Fr.; a small blister, or elevation, caused by the effusion of serosity under the epiderm. It is sometimes used by English authors, and universally by French, to designate the small blisters which are observed on the feet and hands, from long walking, pressure of shoes, or severe labour, such as rowing, &c.; in such cases, they are mere watery pustules, of greater or less extent, over which the sense of touch is enfeebled or totally destroyed. But they are also occasioned sometimes by sudden and violent pressure, as, for instance, when a part is pinched between two hard bodies; the serosity in the latter case, instead of being clear, is bloody, and the colour of the ampulla is dark red.

In the heat of summer, they often occur, even from slight pressure on the heel or toes; owing to the great resistance of the epiderm in these situations, it is elevated so uniformly that their existence is not recognised until they produce tension and pain. When they are extensive, and the epiderm strong, the serosity may be retained so long that its qualities are altered, and it becomes very fetid; if small, the watery effusion is absorbed. In general, it is best to empty the ampullæ by making small punctures; in the extensive ones, an incision should be preferred: the soreness and inflammation arising from the retention of the serosity, should be soothed by a poultice after the removal of the macerated epiderm: the inflammation once abated, compresses wet with a solution of acetate of lead will suffice for the cure.

Their appearance has some resemblance to the phlyctenes of a burn or scald, but they are at once distinguished from them on referring to the cause that produced them.

(*Wm. B. Costello.*)

AMPUTATION, from *amputare*, to cut off; *amputation*, Fr.; *Abnehmung*, *Absetzung*, Ger., signifies the operation of cutting off a limb, or a portion of a limb. This is the proper surgical meaning of the term, in its usual, though somewhat restricted acceptation, and the only one to be attached to it in this article. We say restricted, because the term has other significations. Thus, *resection*, or the cutting off the ends of bones; the removal of the lower jaw, in whole or in part; the excision and extirpation of soft parts, such as the tonsils, the testicle, the uterus, and still more appropriately, the penis, are operations often termed amputations.

The word amputation is also sometimes used as a generic term, including all the above-named significations; and then it is synonymous with *ablation* and *apharesis* (see these words) which, in this sense, are more suitable, and more frequently employed.

Amputation is a subject of such great extent and importance, that it is highly desirable in attempting to treat it fully, to arrange the matter belonging to it,—the various and multitudinous topics it embraces, in an order which will prevent omissions, and serve to impress it well on the understanding.

General remarks on the limbs.—The subject before us involves topics of the highest importance. Such is the nature and structure of the limbs, their importance to life, and the enjoyment of life, that the responsibility of the surgeon who removes or curtails them, can hardly be overrated. We deem it, therefore, right to make some brief reference here to their anatomical conformation, their uses, and their vital importance. Organs of more or less complex and varied motion, of general and often of special sensation, the limbs, considered with regard to the wide and philosophical meaning of anatomical structure, are evidently all modelled upon the same type, in all animals. Modified to suit the habits and destiny of the being to which they belong, they seem to become more and more important comparatively with the rest of the body, as well as in comparison with the same parts in other animals, in proportion to the importance of that being in the animal scale.

From the nature of their functions it follows that they must be composed of substantially different parts, arranged so that the combination shall assume a form varying according to the purpose it has to answer, but always more or less elongated.

The muscles are evidently the most important and characteristic of these constituents. The muscular tissue may be considered as the essential as well as the most abundant element of the limbs, as of every other organ of motion: these muscles being under the direct and immediate influence of the nerves which, as it were, confer upon them, in a great degree, their motile faculty; the nervous tissue is the element, at least second to, if not equal in importance with the muscular.

In the third place, the limbs have their framework, or skeleton, properly so called, which being otherwise almost inflexible, is subdivided, in general, transversely, into pieces made to move upon each other, and upon the trunk, by joints. This, their passive or mechanical part, seems to be their least essential constituent,—a mere sub-stratum; for we find it absent in organs destined almost exclusively to the purposes of motion, such as the tongue of most animals, and the proboscis of the elephant. It is certainly subordinate to the other parts, and formed of an element which, although it may be considered the universal material of organization, is always subordinate or passive also—the cellular tissue. Finally, we see entering into the composition of the limbs, for the purpose of sustaining their general organization, arteries, veins, and lymphatics, which convey to and fro the materials of their nutrition. Muscles, nerves, bones, vessels,—these, then, united by cellular tissue, enwrapped by a fibrous sheath with more or less numerous partitions, and covered by the skin, are the parts with which the surgeon has to deal in amputation.

In surveying the animal kingdom, as we ascend the scale, we find the limbs and their constituent parts, or immediate elements, becoming more and more complex and important, and each part apportioned in quantity and development to the uses for which it is designed: where strength is required, we find the passive; where agility, the more active elements predominating; and where a special sensation resides, we see an appropriate modification of parts to admit of that also.

In this survey we also find the limbs becoming less and less mere appendages, less and less independent of the body, or more and more essential or integral parts of it, as we examine them from an animal of less to an animal of greater importance; and it will be found that, in the same animal, the relative degree of importance, and therefore the danger and detriment of the removal of any particular limb, as compared with the others, may be appreciated by a reference to its anatomical composition, to the importance and relative quantity of its anatomical elements.

The increasing vital relation between the trunk and the limbs, and the proportionately increasing severity of the loss or removal of the latter, appears to be an important law which holds good generally, from the animal possessing the power to reproduce these appendages, to that in which the amputation of one of them is so severe as to threaten life. Exceptions will of course be found where modifications are required for particular cases; where an animal may have two or more of its limbs extraordinarily developed or extraordinarily diminished to suit its particular habits and destiny. In the case of greater development, the connexion of such limbs with the trunk, and the severity of their removal would be greater than in that of the general rule; and in the opposite case, less.

With strict regard to the philosophy of anatomy, perhaps the limbs may be considered, even in all animals, as the elements of the trunk prolonged. But if this view be taken of them in the lower animals, how much more strongly and completely may it be said of them in animals of a higher order. In man, and in most of the mammalia, the limbs, strictly speaking, are but prolongations of the trunk. Are not their nerves prolongations of the nervous matter of the trunk? Their arteries, veins, and lymphatics the selfsame tubes as those of the body prolonged into them? And do not the filaments of the great sympathetic, which creep along these vessels, connect the limbs to all the other parts of the body, internal and external, in the same manner as they connect and harmonize the viscera among themselves?

It is so, and on this account it would be no fiction to declare that amputation of both thighs at the hip-joints, is in some respects almost like the removal of one half the body.

We are convinced that the surgeon who appeals to his anatomical knowledge will take this view of the limbs, and feel that they are more, much more than mere contiguous appendages of the body. He will not allow the notion of lopping off a branch to save the trunk, to take too great possession of his mind, and prompt him to untimely amputations; but, on the contrary, will exert his best energies to combine means and chances with a view to heal and save both.

Not to mention their vital importance, their intricate and beautiful construction, how ornamental as well as serviceable are they! What a difference does man present when we contemplate his body possessed of these valuable endowments, and when we see it shorn of the least portion of them! Disguise as you will the loss of limb, the deformity must be great. Not even the sentiments which endear to us those who have sustained such a loss in defence of what we deem most worth the sacrifice are sufficient to symmetrize to our view the mutilated person of the most gallant hero. We look upon the sailor who has lost a limb in the service of his country with feelings of regard and sympathy. But neither these, nor the triumphant feeling that his life and honourable scars attest the power of surgery, can counterbalance the painful commiseration excited by the cruel curtailment of his person, and stifle the rising sense of shame and regret that it should still be necessary to employ the arts of war to mutilate mankind, and outrage the noblest work of the Creator.

Historical Notice of Amputation.—By the history, or historical notice, of an operation, surgical writers generally understand little more than a brief sketch of the changes it has undergone, with the mention of the names of the authors of those changes, and of the periods at which they have been effected; and in this signification only the title of the present section is intended to stand.

The natural separation of the limbs in cases of mortification first taught mankind that curtailments of the body might be borne without loss of life, and would sometimes be a means of preserving it. The same lesson might have been learned from the accidental tearing off of a limb (in which case there is no hæmorrhage,) but it is probable such an accident had no share in introducing amputation into surgical therapeutics; because by the earliest writers on surgery, and even by those who flourished as late as the thirteenth and fourteenth centuries, the operation is mentioned only in connexion with cases of mortification. Those authors did not dream of amputating except in cases of gangrene.

Hippocrates, who says but little on amputation, appears to have been of opinion that the operation was first suggested by the natural separation of the dead from the living parts after mortification. What he states concerning it is, as far as it goes, like most of his statements, correct and valuable. He indicates the chief danger of amputating to arise from syncope (induced, he undoubtedly means, by loss of blood,) and advises as most likely to prevent hæmorrhage, the adoption, after the operation, of a cool, light regimen, and the horizontal or rather elevated position of the stump.

The first description of what may be called a *method of amputating*, is given by Celsus. It is a remarkable but undeniable fact, that in many parts, the surgery of this author is scarcely inferior to that of the present day. His plan of amputating is decidedly the best proposed up to the time of Jean Louis Petit; and, indeed, some of the precepts given in it must ever form part of the rules for performing a good amputation. He states that the soft parts are to be divided down to the bone between the living and dead ones, but so that some of the former be removed rather than any of the latter should remain, and so that the incision fall not against a joint; that they are then to be drawn back and dissected off so as to leave some of the bone bare; and that the latter is to be sawn through close to the flesh adhering to it. But although in his fifth book, Celsus directs us, in cases of obstinate hæmorrhage from wounds, to tie the bleeding vessels in two places, and then to divide them between the ligatures, he does not appear to have known that the ligature, or any other efficient means might be used for preventing or stopping hæmorrhage in amputations; for he not only omits recommending any, but confesses that the patient often dies from loss of blood during the operation; and there is nothing in the manner in which he directs the stump to be dressed calculated to stop the bleeding from it.

Archigenes is supposed to have rendered amputation more safe from hæmorrhage than his predecessors, by tying the principal vessels with a ligature, either passed through, or embracing the whole limb, to which he also applied cold water. He was thus enabled to perform amputation in the living parts, which he appears to have been the first boldly and decidedly to practise. He took pains to save the skin by fixing it back before beginning the incisions; cauterised the wound with a hot iron after the operation; and then removed his ligature. He probably used the actual cautery to stop the bleeding from the small arteries; and when he speaks of tying or sewing blood-vessels, he probably means those of considerable size only. The measures of Archigenes were adopted by Heliodorus, whose opinion was unfavourable both to the hasty removal of the limb by a direct uninterrupted section, without drawing back and dissecting up the soft parts, and to amputations performed at the joints.

Galen says very little on amputation. He defended, however, the operation performed at the joints, on the ground of its being, in his opinion, safe and speedy.

Paulus Ægineta, whose name is often mentioned in connexion with amputation, cannot be said to have contributed to the improvement of the operation. He deviated from the precepts of Celsus, by insisting on the necessity of amputating in the dead parts, or only on the confines of the living ones. Among the Arabian surgeons the operation certainly underwent no improvement. It seems, on the contrary, to have somewhat retrograded; for Abúl Kasem recommended that the soft parts should be divided with a knife heated to redness, and that a balsam of sulphur should be applied afterwards to determine the separation of the eschar. Avicenna, however, repeated the rules given on the subject by the Greeks, and directed the incisions to be made rather above the gangrenous parts.

During the middle ages no improvement was effected in amputations. The few changes introduced were rather in a contrary direction. Theodoric di Cervia had the merit of recommending the method of Celsus. Prior to the operation he administered opium and hyoscyamus, with a view of rendering it less painful to the patients whom he afterwards endeavoured to rouse from the effects of the narcotics, by causing them to smell of vinegar and aromatics. Guido di Chauliaco, who lived about the middle of the fourteenth century, was more willing to allow gangrenous limbs to separate of themselves than to employ the knife. He used to enwrap the sphacelated part in pitch plaster, and to exercise such constriction as he considered calculated to facilitate its separation at the place of a joint.

In the sixteenth century, Hans de Gersdorf joined to the operation of Celsus, which he justly extolled, the proceeding of Archigenes, of fixing back the integuments with a band tied round the limb above the place of amputation. He would not use the actual cautery; and instead of employing the suture, which was beginning to be adopted in his time, he enveloped the stump in a pig's bladder.

About this period Maggi indicated the importance of having sufficient skin to cover the stump.

Up to the time of Ambroise Paré, as the means familiar to his predecessors were unsatisfactory, some of them, with Fallopius, employed the actual cautery, while others, among whom was Fabricius, Ab Aquapendente, continued, like Paulus Ægineta, to amputate in the gangrenous parts. Paré, the great surgeon of Louis XIV., introduced the plan of arresting hæmorrhage after amputation, by tying the vessels; a plan of so much importance that it may be considered to have led the way to every improvement the operation has undergone since his time. He used to draw out the vessels from the surface of the wound with a kind of forceps (bec de Corbin), and tie them with a double thread; just, says Boyer, as we are in the habit of tying the umbilical cord. In case the hæmorrhage returned, he employed a needle, and passed a ligature round the bleeding vessels, so as to embrace with them some thickness of the neighbouring tissues, and also a portion of skin, on which he placed a compress, and then tied the knot. Besides introducing the important measure of tying the bleeding vessels of the stump, Paré was the first who explicitly stated that a band should be tied tight round the limb, prior to amputation, not only to raise the skin and benumb the part, but also for the purpose of preventing hæmorrhage during the operation. Of this remarkable man, then, it cannot be too much to say, that he was the first who devised measures to enable surgeons to perform amputation safely, and thus laid the foundation of every improvement made in the operation since his time. As soon as surgeons obtained the power of controlling the circulation, through the discoveries of Paré, they were no longer obliged to hurry through the operation, through terror at the thought of the patient's bleeding to death, but were enabled to turn their attention to the shape to be given to the stump; they also began to think of applying amputation to other cases than those of gangrene.

A new era in surgery may be said to have commenced from the discoveries of Paré; and, as may be supposed, they were too great an innovation to meet with ready or general adoption. Many of his contemporaries, and even some of those who came after him, neglected to give their patients the benefit of these measures, which, combined with the method of Celsus, constituted a better kind of amputation than any which had preceded it; and such was the operation performed by Fabricius Hildanus, and Wiseman. Fabricius introduced the use of the retractor; and, like Paré, after tying the principal vessels, applied the actual cautery to the surface of the stump. Wiseman did not make use of the retractor. He sometimes employed the actual cautery, and sometimes tied the vessels. In either case, he afterwards applied a suture and a compressive dressing of stiff plaster. He joined Fabricius Hildanus in advising that the incisions should always be made in the living parts. Dionis rejected the actual cautery. He was averse to amputation performed at the knee-joint.

Towards the end of the seventeenth century, Lowdam of Oxford, and Verduyn of Amsterdam insisted on the necessity of dividing the soft parts obliquely, so as to cut them into a kind of flap, adapted to cover up the end of the bone; and thus may be said to have originated a kind of oblique or flap amputation. This mode was opposed by Koernerding and Heister, and defended by Messuet of Leyden, while La Motte operated after the manner of Wiseman and Dionis.

Munichs endeavoured to revive the system of amputating in the joints, which happily had been rarely employed since the time of Guido di Cauliaco. He was equally unfortunate in preferring styptics to the use of the ligature.

The next great improvement to that of Paré was made by Jean Louis Petit. More completely master of the circulation than his predecessors, by the use of the superior tourniquet he invented, he could direct his attention still more exclusively than they, to the form to be given to the wound by the incisions; and to him is due the honour of affording the patient something like security against that frightful evil—a badly shaped stump. He invented the method of dividing the soft parts by two incisions, limiting the first to the skin, allowing this membrane to retract, and then dividing the muscles. Petit was also one of the first who advocated the propriety of amputation for incurable aneurisms and certain cases of caries and gun-shot wounds.

Shortly after the invention of this method of operating, Ledran performed amputation, for the first time, at the shoulder-joint; and Garengeot, Lafaye, and Sharpe proposed plans of executing the same operation.

About the same time, Remi de Vermale and Ravaton revived the kind of amputation proposed by Lowdham and Verduyn, and which, it appears, had been indicated, among the ancients, by Heliodorus. They modified it, however, so much as to make in it two flaps, instead of one; and from them, therefore, the flap operation, as it was adopted by Dessault, and is now usually performed, may, perhaps, fairly be said to have taken its origin.

At this period of the history of amputation, names thicken upon us. Many of the questions relating to it were treated of scientifically by Monro, Guénaud, Blomfield, and others; but no important change appears to have been projected, until Louis propounded his doctrine with regard to the unequal retraction of the muscles. Upon this he proposed to alter the operation of Petit, by making the first incision divide both the skin and superficial muscles, and the second the deep muscles only; a plan very like, if not the same as that upon which Ledran was accustomed to proceed.

It had often been a question with surgeons what cases ought to be treated by amputation; and from being agitated at the Académie de Chirurgie, it was generally discussed at this period, and among others, by Boucher, Faure, Morand, Bilguer, and Shunuker. Shortly after, a good deal was said of amputation in the joints, and surgeons were bold enough to perform it at the hip. Morand was one of the first to describe this operation scientifically.

In 1779 Alanson proposed a plan of amputating, the novelty of which consisted mainly in the dividing the muscles obliquely upwards towards the bone, by one sweep of the knife; but of which the chief merit lies in the measures it prescribes for preserving a sufficient quantity of skin to cover the whole surface of the stump. His mode of cutting through the muscles was found very difficult, if not impracticable; but the publication of his observations had considerable and perhaps the chief influence in introducing the practice of dressing the wound so as to cause it to unite by first intention. Although this practice is generally attributed to Alanson, Benjamin Bell justly claims some share of the merit of it, in his description of amputation, where he states, that from the year 1772 he laid it down as a maxim not to be deviated from, to save as much skin and cellular substance in the removal of tumours, whether cancers or others, when the sound parts admitted of it, as would completely cover the sores; and in amputating any of the extremities, to save as much of them as would entirely cover the stump. At all events, this plan of causing the stump to heal by first intention—and no fading laurel it is—belongs to English surgery.

It was adopted by Hey, and very soon by most of the British practitioners, whose amputations thus became more successful than those of the surgeons of other countries.

In the method of operating described by B. Bell, who, for the complete and scientific manner in which he treats of amputation, takes the lead of his contemporaries, the plan of preserving skin enough to cover the entire stump is combined with Celsus's mode of cutting through the muscles. The manner of dividing the muscles by layers, as now adopted, is generally attributed to Dessault; and it is certainly mentioned as his practice, in his works by Bichat, although the case of amputation of the fore arm there recorded as an illustration of it, does not present a methodical description of that part of the operation exactly as it is executed at the present day. All the three last named surgeons employed straight in lieu of the old curved knives, and dispensed with the band, which before their time it was the general custom to tie round the limb, either to benumb the part, or to mark the line of incision.

In the modern method of amputating, the skin is preserved for covering the whole of the stump, and the muscles are divided by as many distinct incisions as there are layers. It is only true to say, that from the time of Alanson, English surgeons have ever been distinguished for the excellence of their amputations. They, more strictly than any others, adhered to his rules for preserving the skin; and these, combined with the present mode of dividing the muscles, constitute the best possible kind of circular amputation.

The history of amputation, while it exhibits evidence, both of the reluctance that exists in some minds, from an adherence to customary practice, to adopt what is new; and of the disposition in others, from the desire of change, to undervalue what is old, still offers, as to ultimate results, an instance of the positive though slow advance of science. The operation has ever been influenced by the general state of surgical knowledge, and has varied accordingly; but nothing contributed so much and so directly to its improvement as the discovery of the means of preventing hæmorrhage.

As may be observed with regard to almost every branch of art and science, this part of chirurgical therapeutics has had some intervals of stagnation, and even of retrogression. Upon the whole, however, its periods of change have been those of amendment; and, although sometimes stopped or misdirected in its course, it has at last attained that degree of perfection from which, we trust, it will never recede, and beyond which, it may be difficult to make it advance.

Classification.—Amputations differ from each other in many respects. It will be found they may be best arranged according to the method of performing them, and according to the limb and part of the limb at which they are performed. There is more than one method of amputating applicable to every or almost every part. Each plan which is of such general application that it can be applied to any part, may be properly termed a *general* method. For example, the amputation of any part may be performed so as to leave a wound with one or more elongated portions of soft parts, called flaps, for covering and healing over the bone which remains; and when so performed, it is termed the *flap amputation*. This being applicable to every, or almost every limb and part of a limb, constitutes a *general* method. The same may be said of the plan in which the soft parts are left of the same length all round the limb, and which is called the *circular* method; and the same of that which, from the form of the wound, is termed the *oval* method.

As each limb or part of a limb may be removed by more than one method, there are as many individual amputations as distinct parts to be amputated, multiplied by the number of methods, and modifications of methods, or processes applicable to them.

We understand, then, by a *general method* a mode of amputation applicable to every, or almost every part; and by *individual amputation*, the amputation of some distinct part, by each or any method or process considered separately.

There are certain considerations which apply to all methods of amputating, and to all amputations, taken in the aggregate; and which, to avoid repetition in the treating of each of them, and in order that the reader may have the whole subject clearly before him, we shall present first and together: while whatever applies solely or more particularly to each *general method*, or *single, individual amputation*, taken separately, will be noticed under the head of that general method, and of that special amputation.

As the first considerations apply generally to all amputations wherever, or by whatever plan performed, to general methods and to individual amputations, they ought to precede the description of both. The different general methods of amputating as applicable to any part, come naturally, and will be treated of next in order; and, lastly, we shall treat of every individual amputation of every part, by each and every method and modification of method which has been devised.

CASES IN WHICH AMPUTATION OUGHT TO BE PERFORMED.

In treating of amputation, most authors endeavour to point out the diseases for which it should be performed. But it is evident that a general statement, made with this intention, can be but an enumeration, of little use to the practitioner, and that he ought to look upon it as scarcely more than a catalogue or table, showing at once the number of disorders, or species of cases, for which the operation is performed. Otherwise considered, or with any other importance attached to it, it might mislead the young surgeon. The proper place for pointing out each case requiring amputation, is that, where all the details concerning it can be most completely and minutely entered into; and that place clearly will be under the head of each disease, when we enter into the description of the treatment suited to each or any of its particular cases considered separately. What we ought, and shall more particularly attempt to do, besides making the above enumeration, is to lay down general rules to assist the surgeon in solving the difficult problem—for what cases ought amputation to be had recourse to? In order to come to as just a decision as possible, as to whether or not amputation should be performed, in any case under consideration, the surgeon must always proceed in the same manner. The great object is to calculate the consequences that must ensue, both with and without the operation: in order that of the two courses—its adoption, or rejection—that may be pursued which offers the greater number of chances in favour of the patient's life and health. We have to calculate on the one hand, the consequences of the disease treated by amputation; and on the other, its consequences treated without amputation. We have to compare the consequences on both sides, and to determine for the alternative which leaves the larger residue of probable good.

To solve the problem, all the data must be taken which the answers to the following interrogatories will furnish. What are the exact parts, and to what precise extent is each injured or diseased, taken anatomically, part by part? What are the usual effects, local and general, proximate and remote, of the lesion or disease affecting them? and what will they be in the case in question — that is, under the particular circumstances of the patient with regard to age, sex, physical, mental, and moral constitution, previous and present habits, place of abode, climate, season, and the care and attention that can be obtained for him? Having such data, the surgeon will be able to foretel the issue of a case with a degree of certainty proportionate to his pathological knowledge; and it is here that he will appreciate the value of a thorough acquaintance with pathology, and feel amply repaid for all the pains its acquisition may have cost him; for upon this only can he rely.

By nothing less than a systematic and elaborate investigation of all the circumstances of a case, can we expect to form an accurate opinion on the point in question. Let no man believe that his experience has endowed him with the power of judging correctly by any other method of proceeding. Let no man be tempted by the love of the marvellous to fancy himself a prophet. There must be no plunging at a conclusion: the shrewdest guess may lead to a woeful mistake; and nothing can be more reprehensible than yielding, in the least, to the suggestions of a spirit of divination or instinctive sagacity, which, if we proceeded without method, might have some influence, and in which a sort of self-complacency, derived from previous success, may sometimes induce us conscientiously to believe ourselves in possession of.

When the consequences which will ensue in any particular case, under the two modes of treatment,—that by amputation, and that without amputation,—(and, in considering the former, the shock of the operation must be taken into account,) have been correctly estimated and summed up, the surgeon has only to range them side by side, and to compare them. He will amputate where the consequences of the treatment by amputation establish the greater number of chances in favour of the patient's life and health; and he will not amputate where these chances are established by the treatment without the operation. This appears to us to be the rule by which he ought to be guided. Authors usually state that amputation ought only to be performed where the life of the patient cannot be saved without it. French writers express themselves to that effect[1]. But this is not the rigid expression of the rule. To make it so it would be necessary to say "where health as well as life cannot be saved without it." For there are cases where the *life*, but not the *health* can be preserved without amputation. Suppose, for example, the consequence of a local injury treated without amputation to be a frequent disturbance of the patient's health, interfering materially with his well-being, but insufficient to put life in danger: it does not always follow that this treatment is right or justifiable. It follows on the contrary that if restoration to perfect health would have been the consequence of the removal of the limb by amputation, the treatment with the operation might possibly be the proper treatment.

A man came to the Hôtel Dieu who had lost his right abdominal limb below the knee, from mortification produced, he said, by the use of bad bread containing ergoted rye. His object was to know if anything could be done to better the condition of the stump, the soft parts of which were constantly ulcerating, in consequence of the bones being prominent. The inconvenience was such that he could not make use of his limb for walking, and the cicatrix pressed upon by the bones was so painful as greatly to impair his general health. Now, let it be asked whether, at the time of the mortification, the proper treatment would not have been the removal of the limb by amputation, so as to leave a good, useful, and painless stump. This conclusion seems inevitable. On the one hand, the process necessary for the separation of the dead parts, (of itself probably more or less dangerous to life,) entailed upon the patient a source of constant suffering and great deformity. On the other hand, amputation, perhaps not equally, but we will say equally dangerous to life, would probably have secured a healthy, useful stump. There can be no doubt then that the treatment by amputation would have been the proper one; and yet the treatment without it is that suggested by the rule given by authors; namely, that amputation is to be performed only in cases where the patient's life cannot be saved without it. We do not mean it to be implied that surgeons often act thus, but still, we deem it important as far as possible, to supplant whatever precepts are indefinite and incomplete by positive and fixed rules. In a case like the above, the choice between the two modes of treatment must rest mainly upon their comparative danger. If the probabilities of danger are greater on the side of amputation, so much so as to outweigh the probable inconvenience or occasional disturbance of health entailed by the preservation of the limb, unquestionably it ought not to be adopted; but if the probable danger is about equal under both plans of treatment, the operation ought to be performed. The superiority of one plan over the other is just in proportion to the less degree of danger it offers to life and *health*, and not to *life* alone. The proper rule of proceeding, then, in all cases, may be clearly expressed in a very few words, and in its simplest form, would stand thus:—Place the danger to life and health from the lesion treated by amputation in one scale, and in the other, the danger to life and health from the lesion treated without amputation, and let the decision be made in favour of that plan of which the danger to life and health is decidedly outweighed. Where the two plans are equally balanced, and in cases of doubt, the decision should be in favour of that which causes the less pain, and leaves the body the more perfect in form, or with the less deformity or curtailment.

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[1] Neither Velpeau, Blandin, nor even Cloquet seem to have conceived, or certainly to have expressed correctly the rule which ought to be laid down. Sanson comes nearer to it in saying,—"Amputation ought to be performed only when the danger to which it exposes the patient is less than that of the disease." But to be correct, he should have said, "Amputation ought to be performed when the danger and inconvenience to which it exposes the patient are less than those of the disease treated otherwise."

In cases of doubt, the surgeon will, therefore, abstain from using the knife. As we have dwelt a good deal upon the severity of the loss of a limb, with a view to impress the practitioner with the nature of the weighty duty he has to perform, when called upon to decide whether amputation is proper or not; and in order that he may give the subject his utmost attention, we are bound also to remark, that he must not allow his judgment to be influenced by considerations arising from a mistaken notion of what humanity dictates, and which are sometimes pressed by others. What is right is humane, in this as in most other cases. It is humane to amputate, and inhuman not to amputate where the necessity is pointed out by the rule we have supported, just as much as it would be inhuman to amputate, and humane not to amputate whenever the rule does not prescribe the operation. It is not in treating of this operation that we need defend the profession against the imputation, sometimes attempted to be cast upon it, of allowing the fondness for operating to influence its decisions. The amputation of a limb is always a painful duty to the surgeon. In some operations it is not so: in removing a tumour dangerous to life, he may, indeed, execute the task with a feeling of satisfaction; for he knows that he is extirpating morbid matter, that he is dislodging an enemy. But when amputating a limb, he feels that he is taking away an integral part of the body, which cannot be replaced, for the uses of which there is no substitute, and for the loss of which there can be no compensation.

It is, perhaps, true, that amputation is generally considered the most wonderful of all operations. The notion that prevails in the minds of the uninformed, of the parts entering into the composition of a limb, cannot be so very vague, since we hear persons every day express astonishment that it should be in the power of man to remove the limb of his fellow with knife and saw, stopping the streams of blood that burst from the wound, and so facilitating and hastening its cure that the rest of the body is preserved sound, and in a brief space of time scarcely a scar remains to tell that the patient was not born without the curtailed member.

There certainly is no operation which makes the surgeon appear so great; but we trust this will only make him the more cautious never to abuse the masterly privilege, and consent to remove a limb until his duty command it. In every case, after duly weighing all that can conduce to a right opinion, he will retire in close communion with himself and decide to the best of his calmest judgment.

Thanks to the progress of science, the number of cases in which amputation was formerly had recourse to, is constantly diminishing. As our knowledge of disease, and the modes of counteracting it increase, we are enabled to do more and more without the necessity of resorting to this last expedient.

We now come to the enumeration of those diseases and lesions which it is customary to put down as more or less frequently requiring amputation.

They are as follows:—Malignant diseases, such as the various forms of cancer; some tumours not malignant; mortification; caries; certain of the severest forms of necrosis; white swellings; extensive suppuration, with or without ulceration; fractures; dislocations, and wounds.

Malignant diseases.—It is right to perform amputation for these affections, when there are insuperable obstacles to their complete extirpation without it; whether they have their seat in the soft parts, in the bones, or in both. They are, osteo-sarcoma; spina ventosa; the colloid, hydatoid, and encephaloid transformations; the malignant erectile tumour, (fungus hematodes,) and the divers forms of malignant disease in which these or a certain number of them are blended together, with or without other tissues, and which are generally described under the vague terms of cancer and carcinoma. Unfortunately, however, many of these diseases, being not strictly local, but merely part of the effects or manifestations of an alteration of the solids and fluids generally, break out in the stump or in some other part of the body, especially if energetic measures are not adopted simultaneously with the operation to correct the vitiated state of the whole system.

As we can hardly expect to effect this beneficial change when the malady is of long standing; and that in some few instances a disease of this sort, which at a late period shows contamination of the whole frame, is so far local at first, that without some local cause it might never have been concentrated sufficiently in any one part to break out in an active and destructive form, the sooner the operation is performed the greater must be the chance of a cure. In these cases it is always advisable to amputate as far as possible from the seat of the disease, and whenever practicable to leave an articulation between it and the place of operating. Experience has shown that parts are contaminated, in a great measure, in the ratio of their vicinity to the disease; and it is for this reason, as well as on account of the more complete removal of tissues decidedly morbid by amputation of the limb affected, than by excision or extirpation of the parts immediately diseased, that the former has sometimes been successful after the latter had failed.

Tumours not in their nature destructive to life.—Among the diseases sometimes requiring amputation, may be placed certain tumours which cannot otherwise be removed, and which, although not of a malignant character, exercise a dangerous local influence by their volume or position. Such are certain exostoses and fibrous masses, which by their pressure on large vessels impede the circulation, and may sometimes occasion mortification, or which, by irritating and cramping the nerves, become insupportable. Elephantiasis[1] has also been treated by amputation.

Aneurisms that have produced irreparable injury to surrounding parts, or the treatment of which, by ligature, owing to the diseased state of the vessel tied, has been followed by secondary hœmorrhage, come in the same category. Whenever vessels are so injured that the circulation cannot continue in the limb, but may go on in the stump, (which sometimes happens, since diseased arteries will often perform their functions in the middle or upper part of a limb when they cannot at its lower extremity,) amputation is the only resource, and ought to be adopted.

Mortification, or Gangrene[2].—It is deemed advisable to perform amputation in cases of mortification, in order to spare the patient the long and sometimes hazardous process, which Nature requires for the separation of the dead parts, and for the purpose of securing a good and useful stump[3].

With these, we think a third motive ought sometimes to be allowed to have influence, namely, that the operation itself may produce a salutary effect upon the system. Where mortification of the whole, or of the chief constituents of a limb is produced by an external cause, amputation ought always to be performed, unless there be something in the state of the patient to forbid it. It is a question which has often been discussed, whether or not amputation should ever be performed before the mortification has limited itself. In injuries, such as gun-shot wounds, some parts are quite disorganized, and may, therefore, be considered dead, or in a gangrenous state, from the moment of their infliction; others are so far disorganized that the vital processes cannot go on in them, and therefore, they die at the very commencement of the local inflammatory effort which is necessarily consequent on all wounds.

For lesions of this sort,—indeed, for all traumatic and mechanical injuries of this severity, the sooner amputation is performed the better, as there can be no doubt of the advantage of substituting a clean healthy wound and a cicatrizing process for a ragged laceration and sloughing process, at the earliest possible period. To effect this, the great care of the surgeon must be to cut above the disorganized parts, to let the knife and saw fall upon healthy tissues.

When mortification results from an internal cause, the latter may be general, that is, it may result from a disease pervading the principal part of the vascular system, or having its seat in some other leading organ or organs; or that cause may be local, may reside in, and be confined to the vessels of the limb; and it is only in the latter case that amputation is applicable. There is, however, a state in which amputation may be advisable, which I do not find that authors have marked,—that in which the solids and fluids happen to be in a deteriorated condition at the time of the infliction of some local mechanical lesion.

Here the general bad condition of the body may cause mortification after an injury of the limb, which, in a healthy subject, would have escaped it.

Now if the operation in this case were likely to produce a salutary reaction, which I think possible, it would be justifiable to adopt it. In such a case, where it is hoped the operation itself may have a general beneficial influence, it should be performed at the time the patient appears most susceptible of the healthy reaction; and I think that will be early. Waiting for the gangrene to limit itself would be waiting for what could not take place. I admit that the difficulty of distinguishing this state is extreme, but when detected, no time should be lost.

When mortification is the result of internal disease, the operation should not be performed until an inflammatory line in the living parts has marked its limit. In this case, it were useless and cruel to amputate prior to the spontaneous limiting of the gangrene. Perhaps in this case it may be often better to leave the amputation to Nature. It has been stated that when amputation is performed before the mortification has stopped, the stump will become gangrenous, whether the cause of it be external or internal. But is this sound doctrine? Is there any physiological reason why mortification from a cause purely external should make its appearance in healthy parts cut through in the operation? Indeed, one can scarcely see how it should happen. A local injury, as we have stated, causes the death of parts at once, by completely disorganizing them; or it so far disorganizes them that they cannot bear the supervening inflammation, but die in that process which is then said to terminate by gangrene. But mortification from a local cause is not in itself a spreading disease, as Larrey and some others seem to suppose: it is the death of a part from disorganization. When death seizes the surface of the stump, it arises from one of the three following causes: Either from the shock which the whole body received with the local injury, or because it was in a deteriorated condition at the time the injury was inflicted, and remained so at the time of amputation; or because the operation was performed in parts not sound but too much injured to take on or sustain healthy inflammation. This last cause accounts for the difference of opinion existing on this subject, and enables us to explain why Sharpe, Pott, and others, who had often seen mortification lay hold of the stump, insisted that the operation should be deferred until the mortification was arrested by the formation of an inflammatory circle[1].

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[1] Mr. Crosse lately amputated in a case of elephantiasis, and the result was successful.

[2] These are synonymous terms, and we use them as such.

[3] Sir Astley Cooper thinks that Nature separates the parts so as to leave a good stump.

Caries.—We now know this disease to be an inflammation of the osseous tissue, in the stage of softening or suppuration, and can therefore account for its attacking, in preference, that part of this tissue which is loose and vascular, as we find it in the short and in the extremities of long bones. At a certain stage of caries, the bony tissue is irrecoverably disorganized; and as the consequences of the disease may prey upon the constitution till the life of the patient is exhausted, there are many cases of it which require amputation.

It is the chief and most incurable alteration which takes place in a vast number of those diseases, blended under the indefinite name of white-swelling.

In general, it is only at the very outset of caries that there is any chance of restoring the affected parts to a healthy state; (and except in cases of early efficient treatment, and those in which it terminates by anchylosis before the constitution is irrecoverably impaired,) whenever it is too extensive to allow of the removal of the diseased bone, we have only to choose between amputation and the death of the patient. Amputation is a good remedy for caries when otherwise incurable; because, as experience has proved, the health of those affected, and whose original conformation is mostly the great cause of the disease, often improves after the operation; not only from the removal of the source of mischief, but because the quantum of vital energy as if previously too small for the entire body, becomes sufficient for it after the curtailment of a limb. Certain it is, that the bodies of such persons do often prosper, if they resist the shock and immediate consequences of the operation.

In caries, then, when the bone is decidedly in a softened and suppurative state, beyond the chance of recovery; and when important organs are seriously menaced by the progress of the disease, there should be no hesitation about performing the operation. For the reason we have mentioned, that in this case the lopping off a diseased branch is often of profit to the trunk, as well as on many other accounts, amputation will mostly be found preferable to resection.

Necrosis.—Happily, what we have said of caries does not apply to this disease. It is only the very worst cases of necrosis that require amputation, since by skilful local treatment and good management of the health, if there be adequate strength of constitution, and the periosteum and surrounding parts are sufficiently sound to provide a new bone, the sequestrum will become detached, and may be extracted with safety. But it does sometimes happen, when the disease is very extensive, and situated in the midst of very voluminous and important soft parts, through which the sequestrum cannot be attacked, that the abundance of suppuration would cause death, unless amputation were performed. A patient at the Hôtel Dieu, whose body I examined, died from this cause. The femur, in its three inferior fourths, was reduced to a sequestrum, and shut up in a new bone, out of which nature had endeavoured to let it escape by spontaneous perforations. Unfortunately, these holes were situated in the vicinity of the crural and popliteal vessels. Had they been in the anterior or the outer region of the bone, the nature and extent of the disease might have been correctly ascertained, and the patient's life might have been saved by the extraction of the sequestrum; or had this been found impracticable, by amputation of the limb. The absence of a correct diagnosis as to the precise local circumstances of the disease cost the patient his life.

White swellings.—Diseases of the joints, taken in reasonable time and treated methodically, may generally be cured without amputation, unless the bones have arrived at that state of caries which we have already pointed out as requiring the operation. This happy result belongs more particularly to modern practice, and is to be attributed to our better knowledge of the morbid changes to which the constituent parts of the joints are liable, and of the order in which they occur. At the present day, a vast number of limbs having their joints diseased are spared, which, formerly, would have been amputated. Great credit is due to those practitioners, who, by patient perseverance in the employment of means founded upon pathological knowledge, first obtained a sufficient number of cases to make an impression on the profession, and caused them to pause and employ these measures with that patience, energy, and assiduity which the expectation of a successful issue always inspires, before they resorted to amputation. The delay their employment occasions is by no means dangerous or unfavourable to the success of the operation, which, should it become necessary, will be found less likely to fail after the disease has become very chronic, and made the pulse feeble, than at an earlier period. Indeed, it is the duty of the surgeon to wait and continue to employ such measures, until the patient's general health shows that he would sink under the disease, if the limb were not removed.

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[1] At a time when our pathological knowledge was less perfect than it is at present, mortification was mistaken for a sort of active process, or spreading disease, because in most cases it begins at the extremity of a limb, and gradually extends towards the trunk, and thus seems to spread by a sort of contagion. But this happens because the vital processes diminish gradually in activity, and are carried on with increasing difficulty, from the centre towards the extremities and surface, and that these die first from whatever cause mortification proceeds.

Here it is the state of the body, and not the state of the joint, which determines whether and when amputation is required ; for, until the general health gives way, there is always hope of every disease known by the name of white swelling terminating by ankylosis, or in some manner which will admit of the preservation of the limb.

Extensive suppuration, with or without ulceration of the integuments.—Cases of extensive suppuration have been put down among those which may require amputation by some authors. If the patient's life be menaced with exhaustion by the abundance of pus secreted, the surgeon has to consider by what means he can remove the cause of it ; and, if this is local, perhaps, in rare instances, all other means having failed, amputation may be indicated. But where the secretion of pus depends, in whole or in part, upon an internal or general cause, it is evident that the operation would be worse than useless.

It is always dangerous suddenly to arrest the suppurating process, and that in proportion to its extent : and, therefore, when a case presents itself in which local suppuration or ulceration has produced so much havoc as to render a limb useless, and put life in peril, no pains must be spared, (for management alone is scarcely sufficient) to ward off the consequences inseparable from the direct stoppage of a copious purulent discharge. The materials of such a drain must be largely, adequately diverted to other external channels, by the most appropriate emunctories, or their reflux internally, which otherwise could hardly fail to take place, must produce congestion in the internal organs, with that tendency to suppuration which makes it almost always fatal.

Fractures[1].—Compound fractures in which the bones are extensively shattered, denuded, and displaced, especially in the immediate vicinity of large joints, in which the main trunks of vessels or nerves are injured, tendons denuded, and the muscular parts largely destroyed or contused ; the presence of these complications combined, or the existence of one of them, in a manner to constitute an injury which the careful and analytical investigation we have recommended shows to be irreparable, renders amputation necessary. Terrible compound fractures have often been cured, where the general circumstances were favourable, and sometimes even in hospitals, where the patients were not placed in the purest air, or surrounded by the greatest comforts. Dupuytren saved the leg and life of a gentleman in a case of fracture, in which the posterior tibial artery was opened, by setting the bones, and tying the femoral artery, a bold line of practice, originating, as he thought, with himself, but recommended, I believe, by that excellent surgeon, John Bell.

The following case occurred in hospital practice :—

A strong man, about thirty-five years of age, was brought to the Hôtel Dieu, with one of the severest compound fractures of the leg I ever saw. It occupied the immediate vicinity of the ankle-joint. The ends of the upper fragments protruded through a large wound of the soft parts. The foot with the inferior fragments (which were not more than an inch and a half in length), was bodily displaced an inch, at least, on the outside of its natural position, and seemed to hang to the rest of the limb only by tendons. The patient obstinately refused to submit to amputation, although apprised that it was the only means of saving his life. To add to the gravity of the case, traumatic delirium of the worst kind suddenly came on, during which the patient removed the dressings, and used his limb as if it had been entire, so as to cause the foot to hang still more loosely by the connecting tendons. Yet, strange to say, this man recovered. The delirium subsided. In a few days, a mass of granulations sprung up, as if by enchantment, and wrapping themselves round the ends of the bones, they seemed to draw the foot more and more into its natural position, and thus to achieve that fixation which had in vain been attempted by splints and bandages. The projecting extremities of the fragments studded in coral granulations, which presented a most beautiful appearance, became necrosed and fell off, a firm cicatrix ensued, and the man could walk and use his foot remarkably well.

In cases where nerves and large vessels are uninjured, where the joints and tendons have escaped serious lesion, amputation may not be necessary, unless the destruction of skin and muscle be so considerable as to render the formation of a good cicatrix impossible ; or unless the general circumstances in which the patient is placed establish a necessity for the operation.

Splinters of bones can be removed, the ends of fragments can be cut off with a saw ; and when a fracture is thus regularised, it is the state of the soft parts only which can make amputation indispensable. We repeat, the general circumstances of each particular case must be taken into consideration. It is probably their omission in the calculation which has rendered the results of various practitioners apparently so opposite ; some contending that amputation is hardly ever necessary in compound fractures ; others, that it is frequently called for. Among the former, Bardy, and among the latter, Bending, have written in support of these opposite doctrines. Velpeau has recorded some bad cases of compound fracture cured without amputation. Sir A. Cooper's practice abounds with them ; indeed, it is to him that we are chiefly indebted for the treatment by which such favourable results have of late been obtained in this department of surgery. Dupuytren's hospital practice was far less favourable in these cases, which I attribute to the frequency with which he was accustomed to renew the dressing, and thereby disturb the limb. It contrasted strongly with that of Sanson, who adopted Sir Astley Cooper's plan of treatment with much success.

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[1] See Pott's remarks on Fractures.

Disunited fractures, whether they have given rise to the formation of an artificial joint or not, may sometimes occasion such serious consequences as to require amputation, when the evil cannot be removed by other measures.

Luxations.—It is only for compound luxations, properly so called, that amputation is sometimes required. But, for these, the operation is more frequently necessary than for compound fractures. Almost always when articular surfaces are largely exposed, the patient's life is in danger, unless amputation be performed without delay, especially if the surrounding parts are much injured.

The danger is greater than in compound fractures, and arises from the number and importance of the organs in which an injured joint excites sympathy—sympathy of the directest and deepest kind; and also from the difficult and peculiar nature of the process required to repair articular structures. The sympathy between the synovial and the serous system is immediate: and the inflammation of all the component parts of joints is not easily borne. Yet there are many cases in which amputation may be dispensed with, viz: those in which the joint is not extensively opened, and the ligaments are but slightly lacerated; and in dislocations of the foot where the injury, although considerable, may be mitigated by the removal of the astragalus. Sir A. Cooper was one of the first to show what nature could effect in these cases, under skilful management, and to him we are indebted for the history of many such lesions treated successfully without amputation[1]. (See Arthritis, Traumatic.)

Wounds.—There are very few ordinary wounds so extensive and severe as to require amputation. When part of a limb is torn off, it will be found better in general to amputate; but, in some instances, the wound is, or may be made sufficiently regular for the formation of a good cicatrix, without the operation. The various and complex lesions, termed gun-shot wounds, very often require amputation: indeed, it is more frequently indispensable for them than for any other mechanical injuries; not only because they may include many of these, such as fractures and dislocations, but because, *ceteris paribus*, they are in the fullest sense of the word, and more strictly than almost any other lesions, contused wounds. The contusion accompanying them is always intense; being carried, for an extent of parts more or less considerable, to complete disorganization, and for some distance, to a degree bordering on disorganization. The tissues are lacerated, and often contain foreign bodies; the bones are frequently splintered and denuded; in a word, the destruction of parts is great, and those not destroyed are irremediably injured, to a greater or less extent. The margins and surface of gun-shot wounds are, by the event, dead. They present, then, at once, mortification—superficial, perhaps, but still mortification combined with more or less of the other mechanical lesions which render amputation necessary. This is the true reason why they more frequently require it than any other injuries, and not because there is any thing burning, venomous, or malignant, deposited in them by the projectiles which inflict them, as was formerly supposed by Ferri and others. A gun-shot bruise or wound, in which the principal substance of the limb is contused to disorganization, and more especially if the nerves and large vessels are injured, (whether or not there be fracture or rupture of the skin,) is decidedly a case for amputation. Another case is that in which the bones are fractured at their articular extremities, except in rare instances, where the wound is small and the bone merely traversed by a ball. In the very great majority of cases where joints are laid open, and the end of one or more bones fractured, death is the result, unless the operation be performed without delay. This appears to be the opinion of the best surgeons, and of Velpeau, whose remarks on this subject are highly valuable.

That gun-shot wounds, in which the bones are comminuted, also require amputation, seems to be an opinion supported by the best authorities: those of the thigh and leg almost always require it[1]. The shattering of the limbs from other causes is not quite so serious, and amputation is not so positively indicated.

Tetanos.—To perform amputation for this disease, (a disease so evidently having its seat in a large portion of the nervous system), when it has once commenced, seems absurd. Strange to say, however, cases are recorded in which it is stated to have been successful. If such a result has really been observed, it can only be explained upon the supposition, that a cure of the disease of the nervous system was effected by a sort of counteraction excited by the operation. That the disease can be cut off with the limb seems impossible. Amputation can be scarcely justifiable here, since a far greater number of cases of tetanos, said to be authentic, have been cured by measures incomparably less severe than that which involves the sacrifice of a limb.

We admit that under unfavourable circumstances, and during the prevalence of tetanos, it may be advisable to have recourse to the operation in those cases of severe injury, for which, under influences less disastrous, its necessity might be doubtful. But this is all that can be admitted. In connexion with tetanos, amputation can hardly be considered in any other light than as a preventive measure.

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[1] See also cures by Langier and Arnal.

[1] In public institutions for the reception of disabled soldiers and sailors, few are found who preserved their lower extremities after these injuries. Such lesions inflicted during the last French revolution, even where every possible care was taken of the wounded—where they were surrounded by the most favourable circumstances, produced death, when not treated by amputation, except in rare instances.

Poisoned wounds.—The bites of rabid or venomous animals are sometimes enumerated as cases that may require amputation. But all that has just been said concerning tetanos applies to these. To cut off a part, after the whole body has become impregnated with poison, is quite out of the question. As a remedial measure, it holds out not the least temptation: the physiological ground for its adoption is slender indeed, and the little experience we have of its effects[1] is quite opposed to it. In such cases, the cause of the wound is a circumstance that weighs in favour of amputation, supposing its gravity in other respects to indicate the operation.

Ankylosis and Deformities.—Amputation has been sometimes performed to rid the patient of a merely troublesome or deformed limb. Where, for instance, its different parts have been thrown into such a position with regard to each other, by ankylosis, as to render it less useful, more troublesome, and more of a deformity than an artificial one would be. Sometimes, indeed, amputation has been adopted mainly for the purpose of removing a part congenitally deformed, or rendered so by disease, and of making the body, in appearance, more symmetrical. Such operations are said to have been performed at the earnest entreaty of the patient, and as it were out of condescension on the part of the surgeon; they are, therefore, aptly enough termed by the French, *amputations de complaisance*. But surely this is a degree of complaisance which nothing can justify. It is to be regretted that surgeons should ever yield to their patients' wishes, to this extent; and we are surprised to find so able a man as Velpeau seriously arguing the point, as if there could be any doubt about it. The only case which admits of doubt is that in which deformity brings on disease, or where the two are combined; and for such a case we have already endeavoured to deduce, from right principles, the rule by which the surgeon's conduct should be guided.

Prognosis.—In speaking of the method by which the surgeon should proceed in order to decide, in each particular case under consideration, whether amputation should or should not be performed, we mentioned the necessity of taking into account all the circumstances relating to it.

We have now to notice those circumstances which, it has been correctly ascertained, do affect the result of all amputations, and the knowledge of which is necessary to enable the surgeon to foresee the probable consequences of the operation he may have to perform; in other words, to establish his prognosis.

With respect to age, it may be said that the younger the subject the greater is the chance of a successful issue; for the restorative power of Nature and her capacity to resist the shock of a severe operation, are greater in the early period of life. In old persons the danger is often very great; their tissues are far from their highest state of elasticity, and the wound is apt to heal tardily. As regards the actual state of the patient's body at the time of the operation, it has been pretty accurately made out, that a habit somewhat reduced is more favourable to success than fulness. In the former, the wound resulting from the operation, and consequently the amount of inflammation necessary for its cicatrization is proportionately small; the parts to be divided being free from turgescence, bear the action of the knife without much local irritation, and are not likely to occasion violent reaction in the system. In the latter condition of body, the wound is large, and the incised parts being voluminous and in full vital energy, feel more acutely, and awaken stronger and more extensive sympathy.

The influence of the mental state may be likened to that exerted by the physical state. When the mind has quickly to determine upon making the sacrifice of a limb, it is done by an effort of some cost to its strength, which incapacitates it more or less to bear the operation; while on the other hand, when a patient has been gradually prepared to expect amputation by a knowledge of its probable necessity, a state of calm resignation, which is highly favourable to success, is often induced. Patient and lasting courage is far more favourable than sudden resolve. The patient, however, must never be kept in a state of suspense when once the operation is decided upon. Mental indifference is decidedly unpropitious, especially when it results from a physical shock produced on the nervous system, as we often see in extensive and violent contusions and gun-shot wounds. The patient who does not care about getting well, most frequently dies. Yielding with fear and reluctance rather than with confidence, is bad. The most favourable mental condition is that in which the patient feels the necessity of the operation so strongly as to consider it his duty to submit to it, and to second by his courage and confidence, the surgeon who has to perform so arduous and trying a task.

Constitutions similar, and in appearance equally good, do not bear so severe a shock as that of amputation with the same impunity. We must consider not only the degree of health in the leading and important organs of the body, but also their pliancy; or, as it may be expressed, their willingness to accommodate themselves to a new state of things suddenly induced, and amounting in most cases to a vast change.

This may be ascertained in some measure by an inquiry into previous circumstances. This want of the power of accommodation is soon evinced by disturbance in the principal functions. If the internal organs be unsound, the disease affecting them becomes active and soon kills the patient, especially when it is of the same nature as that for which amputation has been performed; as we see daily in scrofulous complaints. We cannot often expect a favourable result when amputation is performed for a disease likely to return in the stump, or to break out afresh in some other part. The more distant the place from the trunk, and the smaller the part where amputation is performed, the less serious the operation. Amputation performed on the abdominal is more serious than on the thoracic limbs. The plan of operating and the skill of the operator have also something to do with the result. General circumstances, such as the abode of the patient, the care and comforts he can obtain, the climate, season, &c., bear directly on the prognosis of this as well as of all other important operations.

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[1] Mr. Callaway amputated a limb in a case of hydrophobia without the least benefit to the patient.

Time for Amputating.—Although the time for amputating must in general be a *time of necessity*, yet, as there may be some room for choice in this respect, we admit also, if not absolutely, within certain limits, a time of election.

With regard to mechanical injuries requiring amputation, surgeons of the present day seem pretty well to agree that no time should be lost, and that the operation should be performed immediately after their infliction. Formerly there were opposite opinions on this matter. Some maintained that the operation should be performed, at least, within the twenty-four hours; others that it ought to be deferred until after the decline of the general reaction following local injuries. The Parisian Academy of Surgery decided in favour of the latter opinion, when the question was brought before it, about the year 1760. It was there contended, on the one side, that immediately after the shock of a severe injury, the system is in a state of commotion which incapacitates it for bearing the operation; and that delay has the advantage of showing, in each particular case, Nature's power of reparation, which, when great, may be sufficient to save a limb that would otherwise have been sacrificed, from its appearing at the time of the infliction of the injury absolutely to demand amputation. The opponents of this doctrine, on the contrary, urged the absence of inflammation and suppuration before the local disorder has had time to affect the body and create reaction, as an unanswerable argument in favour of immediate amputation, which, they stated truly, subtracts the patient from the trial to which life is put by the local and general reaction which follows severe mechanical lesions. It is certainly true, that it is better to amputate when the body is in a state of calm, before reaction has commenced; but on the other hand, it cannot be denied, that the operation is in itself a shock added to that of the injury.

If it be true that the body suffers less or runs less risk from this shock than from the inflammatory process and accidents that may supervene when the limb is allowed to remain, then clearly the operation may be performed. Experience shows this to be the case. Consecutive, compared to immediate amputation, has been more than doubly fatal; and the few limbs which have been saved by delay are but a poor set-off against the loss of life it has occasioned.

As we have shown in another place, amputation performed during the process of suppuration but rarely succeeds. When the immediate shock of the lesion upon the nervous system is so great as to cause general stupor for any length of time, immediate amputation is nearly always fatal. But, in such a case, does not the patient perish rather from the primary injury solely; and does not death ensue as certainly where the operation has been omitted? If so, it would perhaps be better to amputate, even in this case, because the operation might possibly tend to rouse the patient, and to create a salutary reaction. Notwithstanding the reluctance a surgeon must feel to amputate when the body remains in a state of stupor which affords little or no hope of success, it would certainly be right to perform the operation, if the severity of the injury were so great as to preclude all possibility of saving the limb.

From what has been stated of other disorders requiring amputation, under their respective heads, an inference may be made, with regard to them, as to the precise time the operation ought to be performed. We shall, however, briefly recall, in this place, the rules which have been recommended.

In most cases of mortification, the formation of an inflammatory circle indicates the time for operating; but the exceptions to this rule, which have already been stated, must not be forgotten.

For all malignant diseases, amputation should be performed the moment the complete extirpation of the malady is ascertained to be impossible.

In the few instances of extensive suppuration, or ulceration, for which amputation is justifiable, the time must vary according to the circumstances of each particular case. M. Blandin[1] endeavours to establish a division of suppuration into acute and chronic. — The terms are not strictly appropriate; because all the distinction that can be admitted is that between suppuration of long standing, and suppuration from a recent lesion. He would call chronic that suppuration which results from scrofulous inflammation in the lymphatic glands, and acute that which occurs to separate the eschar of an extensive burn. The period for amputating in cases of extensive suppuration of long standing is correctly stated, by M. Blandin and others, to be when the patient is somewhat, but not too much weakened by the purulent secretion: in cases of recent suppuration, on the contrary, the operation should be performed as soon as it is ascertained to be necessary. For those cases requiring amputation, in which the surgeon has some choice as to the precise period of performing it, and is not strictly tied to time, he should follow the rules laid down for the performance of operations generally: these he ought the more strictly to adhere to, as among what may be termed the major operations of surgery, there is not one of greater consequence than amputation.

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[1] Dict. de Méd. et Chir. Prat., Art. Amputation.

He must not forget that a mild temperature and settled weather are decidedly favourable to success. He ought also to bear in mind that it is better to operate in the morning than at any other part of the day. The morning is the more necessary as the immediate preparations for the operation require some time; and the accidents which may supervene after it (which often require considerable time also) are much better counteracted during the day than in the evening.

Place at which Amputation is to be performed.—There is scarcely any part of any limb at which the operation may not be performed; but it cannot be performed at each and every part with equal advantage.

It is usually practised in the continuity of the limb, that is, by cutting through the bones; but sometimes it is performed at the joints. Whether the latter should ever be the place for amputating, except in cases where it cannot possibly be avoided, is a question, which, being somewhat new, we shall deem it our duty presently to raise and discuss. That this is almost a new question, will appear evident when it is considered that, up to this day, authors make the difference, as to place, the ground of a natural division of amputations into those which are performed in the continuous and those which are performed in the contiguous parts of the bones of the limbs, a division upon which we must therefore offer a few words. We consider this arrangement inferior to our own, inasmuch as the different methods of operating are more or less, although not equally, applicable to the contiguity and the continuity of the limbs. The division we adopt is quite as simple, and admits of a more methodical classification, without requiring, as the other does, that we should go over the same limb, in describing the amputations applicable to it, more than once.

In the arrangement we adopt, the different methods of amputating may be said to constitute classes,—the different parts of each limb, at which amputation, by these methods, may be performed, species,—and the different modifications of these methods at any part, genera. For instance, in describing the amputations performed on the thoracic limb, we have only to apply the different methods and their modifications to its several parts, the arm, elbow, fore-arm, wrist, and fingers. Thus, everything is clear, and there can be no omission. Whereas, by the other classification, there is some confusion, and the necessity of going over the ground twice is unavoidable; because it is required to treat of the amputations of the limbs by the different methods and their modifications, first, in the different regions of their continuity, and then to return and treat of them, in like manner, in the different regions of their contiguity, or at their several joints.

But we may ask,, ought amputation ever to be performed at the joints, when there is any other part of the limb at which it can be performed? We think not; and we believe this decision, which we rest upon surgical and physiological grounds, to be justified by experience. The danger of cutting into a joint, of exposing an articular surface, has been universally admitted since the time of Hippocrates. Wounds of the joints are dangerous, chiefly on account of the severe sympathetic derangement they may occasion: there is a much greater variety of parts at the joints than in other regions of the limbs; and the sympathy they excite seems to be in proportion to the number and importance of these parts.

The synovial system, taken as a whole, has its different parts all over the body closely united by sympathy. The same may be said of the fibrous system, of which so great a portion enters into the composition of every joint. The sympathy between the synovial and the serous systems is so direct, that an injury of the one will often occasion disturbance in the other. Perhaps these considerations alone ought to be sufficient to deter the surgeon from amputating at the joints. Fractures and other mechanical injuries of the limbs are, to a great extent, dangerous in the ratio of their vicinity to joints, and the more so in proportion to their volume and importance. Wounds which would otherwise be of no great consequence are serious and dangerous, when they affect or penetrate into an articulation. It does, therefore, seem inconsistent for surgeons to operate upon them, when not absolutely obliged to do so.

Surgically considered, these operations at the joints are bad. This is shown by the changes which occur in the stump after the operation, and which we shall have to notice hereafter. Bones, being larger at their articular surfaces than at any other part, require there a proportionately larger extent of soft parts to cover them; whereas, with one or two exceptions, the soft parts surrounding joints are not only less abundant, but they are also the least fit for the purpose. Synovial membrane, tendons and their sheaths, fasciæ and ligaments abound at the joints; and these are ill suited to form a stump, or to cicatrize speedily. The inconvenience of their inflammation is excessive: it may give rise to the formation of pus along the sheaths of the tendons, or in the synovial surface of the joint, which, if left, will often suppurate in dangerous profusion rather than unite to the enveloping parts. The surgeon who has witnessed these local disorders, with tendons, ligaments and aponeuroses isolated, and sometimes dangling about the stump, must ever feel reluctant to amputate at the joints.

If, then, it be true, that this local inconvenience is not unfrequent after amputations at the joints; that they sometimes produce a shock on the system which may of itself be fatal; that they almost always excite a more severe sympathetic derangement in the whole body, and kindle a more intense and more malignant fever than those performed in the continuity of the limbs, ought they not to be limited to such cases as admit of no other resource?

Where, from the extent of disease, the section of the limb must be made either at a joint, or beyond it on the side of the trunk, and where the inconvenience of going beyond it would more than counterbalance that of an articular amputation, the latter must be performed. The same may be said of those cases, in which a limb is so shattered or diseased that it must be removed at the joint immediately connecting it with the body.

One of the most recent attempts to defend articular amputations is that of our respected colleague, Mons. Blandin. He even goes so far as to maintain that they are preferable to those performed in the continuity of the limb. In addition to the preceding observations, a slight examination of his reasons for this preference will be sufficient to show they are not well founded. The advantages he supposes to belong to these amputations may be summed up as follows. He states that they admit of the operation being performed at a greater distance from the trunk; that the parts to be divided are tendinous and not fleshy; that the bone presents on the end of the stump a large surface, the union of which with the soft parts is facilitated by its great vascularity, by the absorption of its cartilage, and by the state of integrity in which it is left; whilst a bone that is sawn through has its vessels injured by the section, and therefore becomes less suited to form part of the cicatrix, and its veins more exposed to inflammation.

We will not deny that joints do sometimes admit of the operation being performed at a greater distance from the trunk; and we have already mentioned that this consideration must be taken into the account. In particular instances, this may render them advantageous; but, as a general rule or abstract principle, the preservation of a few inches of the limb is but a poor compensation for the many disadvantages that beset this species of amputation.

To overthrow the other arguments, we can appeal either to pathological principles or to the results of experience.

First, as to experience. It is an undoubted fact that the great majority of practitioners reject these operations, and operate in the continuity of the limb, because, upon trial, they have found them decidedly disadvantageous. Secondly, as to pathological principles, we repeat, tendons and ligaments are incomparably less suited than muscles to cover and protect the end of a bone in a stump and to enter into the composition of a cicatrix: the vital phenomena of the tissues composing an articulation are more slow and occult and less under our control. These tissues are hard, and of a form and texture the least adapted to constitute a cushion such as the limb requires; and their wounds are undeniably more serious than those of the muscles.

To have a large mass of bone at the end of the stump might be advantageous, if a large and unyielding surface were required there; but everybody knows that the pressure which the stump has to bear should be distributed, to as great an extent as possible, on the sides of the limb. No artificial limb is constructed so as to press on the end of the bone; and if it were, the skin squeezed between the bone and artificial member would soon ulcerate.

M. Blandin truly states that the articular ends of bones are their more vascular parts; and if very active vital phenomena were required in the stump, they would be the best suited to form it. But the contrary is the fact. The stump should be, as much as possible, an inert, elastic cushion, not a highly vascular bony extremity.

From being more vascular, these ends are more susceptible than other parts of morbid action and more exposed to its being excited in them, under the new circumstances in which bone is placed after an amputation. We are quite at a loss to know how our author, after remarking on their vascularity, can go on to say, that any other part of the bone is more liable than they to have its veins become the seat of inflammation, because it is cut through with the saw. Inflammation in the veins of a bone, arising merely from the latter having been cut through, in its dense, unvascular, compact substance, is a thing quite unheard of. On the one hand, then, great vascularity in the bone is not required for the formation and uses of a good stump, or to cause it to heal quickly; and on the other, it tends to make it more susceptible of morbid action.

M. Blandin remarks that the cicatrization of the stump is facilitated by the absorption of the cartilage. But does he not hereby imply that the presence of this cartilage is an obstacle to it. If the process of absorption be necessary, and necessary it is, before cicatrization can take place, the latter must be thereby proportionately retarded. We are told, in the same breath, that these amputations are desirable, inasmuch as the vascularity of the articular end of the bone causes the wound to heal speedily, and yet, that before the wound can heal the cartilage must be absorbed. That the greater vascularity of the bone does not at all compensate for the time required for the absorption of the cartilage, (which is a long process) no one can doubt. If, therefore, he wishes for a prompt cicatrization of the wound the argument tells against him.

We maintain, and it is the doctrine both of sound pathology and of experience, that the end of a bone sawed off, in its compact tissue, is advantageous in the stump, precisely because it is small and can be easily covered in, cushioned and protected by soft parts; because it is not vascular enough to be much exposed to morbid action, yet sufficiently so for all the purposes required of it; and because, from having no cartilage to be absorbed prior to cicatrization, it heals promptly.

M. Blandin would have a stump composed of a large substance of bone and a small substance of soft parts; but it has ever been the object, and it has become the precept of the best modern surgeons to make it of much soft parts and little bone; and we know of no facts or arguments calculated to reverse this maxim.

Setting apart the considerations we have just presented with respect to the joints, the place for amputating is to be determined by the nature and extent of the disease requiring the operation, and the state in which the limb and stump will be left after it. It sometimes happens that amputation may be performed at one of several places, and that the case admits of a choice in this respect. Any point thus selected as the best is called, by the French, the place of election *(lieu d'élection)*. Sometimes there is only one spot at which the operation can be performed at all, or can be performed without serious inconvenience; and when such is the case, the French call it the place of necessity *(lieu de nécessité)*. No very absolute rules can be laid down for fixing the place of election, as that must vary somewhat in each particular case. Still the following general maxims should be kept in view. First,—it should always be, if possible, beyond the disease, and in sound parts. This rule must be rigidly adhered to in cases of malignant disease; but it may be departed from where the inconvenience of operating beyond the disease more than counterbalances that of cutting amidst parts not quite sound, as it happens in some cases where the latter are only the seat of inflammation: experience has shown that parts affected with inflammation and even in a hardened and thickened state are not incompatible with the formation of a good stump. In some cases of mortification, where, from the refusal of the patient or some other cause, amputation cannot be performed in the living parts, it may be judicious to remove the whole, or nearly the whole of the sphacelated portion of the limb, in order to remove as much as possible the inconvenience arising from a mass of animal matter in a state of decomposition.

Secondly,—the place of election should be as far as possible from the trunk. The wound will thus be reduced to its minimum of extent, and, in general, of its danger; and in most cases, the greatest usefulness that can belong to a portion of the limb or stump will be secured to the patient. The exceptions to this rule will be indicated more especially in the description of each particular amputation.

Thirdly,—let the place of election never be an articulation. For the reasons already given, let amputation be performed, if possible, always beyond an articulation rather than in it. Combining these rules with the circumstances of each particular case, the surgeon will always be able to decide at what place the operation is to be performed. The place of necessity varies for different diseases. In cases of mortification it is on a level with the inflammatory circle limiting it, or a few lines only beyond this circle. In malignant diseases it is as near the trunk as possible, or, at any rate, beyond the joint interposed between the trunk and the disease. For mechanical lesions, such as compound fractures and dislocations, it is not necessarily in or beyond the joint situated above the disorder, as stated by M. Blandin, but, on the contrary, in the nearest part to the lesion that will admit of the formation of a good stump. In determining the exact extent of any disorder the surgeon must not content himself with a superficial examination; he must not only direct his attention to the state of the skin but also to that of every other element of the limb; otherwise the knife might fall on parts in a state so different to that in which he expected to find them as to require a fresh amputation.

Preparation of the patient.—By discreet and skilful measures, the patient may be influenced favourably, or somewhat prepared, both in body and mind, to bear surgical operations; and for one so severe as amputation they are especially necessary. The patient must fully make up his mind to bear the operation with firmness and courage. The surgeon can assist him to do this by judicious management. To a certain extent, they should consider together the necessity of the operation; and from a proper and unstudied interchange of thought there will arise a mutual confidence which is highly propitious. This obtained, he must enter into the patient's feelings, reply candidly and attentively to all his inquiries; and, by proving the absolute necessity of the operation, by showing that the pain of it although considerable is not intolerable or of long duration, and by fairly stating the circumstances that will lighten and somewhat compensate for the loss of the limb, set all doubts and fears at rest. In general it is not well to urge the patient to submit to it, but it may be proper to recall to his mind the principal circumstances of the case, such as—the means employed without benefit, the inefficiency of any other measure, the disadvantages of further delay—and then to appeal to him for his own opinion whether he does not consider it necessary. It is not easy to give directions in this matter: a great deal must be left to the sagacity of the surgeon, who will adapt his arguments to the state of mind of the patient. There should be as little delay as possible after the patient has made up his mind. The apprehension of the operation must not be allowed to prey on him. He must not be kept in suspense. A good surgeon will therefore take care that any preparatory treatment which requires time, such as the placing of a seton or blister, be believed by the patient to be intended to act against the disease requiring amputation, and not to prepare him for the operation.

The body should be prepared by the best measures time and the circumstances of the case admit of; they should be such as are most likely to establish and preserve a good and calm state of the principal functions. In general the quantity of food should be diminished a good deal, but not changed to the extent recommended by the French, who go too far in this repect, while the English perhaps do not go far enough. There is a just medium to be observed. More is certainly to be feared from too much fulness, improperly called strength, than from too much emptiness. The digestive organs should have something to do, but their work ought to be light: the food should be simple, easy of digestion, and of a nature to procure a motion once in twenty-four hours. The circulating system should not be too full; but as some blood must be lost during the operation, and as the quantity can be increased by allowing the small vessels to bleed for a certain time before the ligatures are applied, preparatory blood-letting is seldom or never necessary. Besides, it might not be always safe, as the precise quantity of blood lost during the operation cannot always be foreseen or regulated, although we believe surgeons might regulate it better than they do, if they attended more to this matter, which, at present, they neglect to an unjustifiable degree.

As to the more immediate preparations, it is requisite to see that the bowels act within at least eight or ten hours of the time for operating. Should they not act naturally, it will be proper to procure a motion by an enema. We do not think the habit of purging patients, prior to great operations, a good one: surely it cannot be right to throw important organs into a state of commotion at such a time. No food should be put upon the stomach within three or four hours of the time fixed for the operation. According to the state and temperament of the patient, either some, mild, agreeable antispasmodic or stimulant may be administered. It was formerly recommended to employ means with a view to render the patient less susceptible of pain. Guy de Chauliac and his contemporaries gave opium internally, and to a certain extent it is still employed by some modern surgeons. Theodorus proposed subjecting the olfactory nerves to the influence of narcotics, by allowing the patient to smell of a sponge steeped in a solution of opium or henbane; and it has been recently pretended that it is advantageous for the patient to inspire some narcotic gas. These measures are all either useless or pernicious. The plan of tying a strap tightly round the limb, above the place of amputating, is perhaps less injurious and has decidedly some effect; but the pressure is equally efficient, and can be made much better and without the inconvenience of arresting the venous circulation and interfering with the muscular contraction, by the hands of assistants.

It is proper to select a room and a bed or table prior to the operation. A room adjoining that in which the patient is to sleep should be preferred; as it is not desirable he should have to be carried far, or that his sleeping-room should be encumbered with the divers preparations necessary for the operation. It ought to have a good light, opposite to which the patient can be placed; there should be at hand cold water, wine, vinegar, and sal volatile. A bed, or table covered with a mattrass, blankets, and sheets, is used for amputations performed on the abdominal limbs, and sometimes for those of the thoracic limbs. It should be firm, of a convenient height, and not more than three feet wide, so that the patient may be closely approached on either side.

Apparatus necessary for performing amputation and for dressing the stump.—This should always be kept ready in Hospitals; and every surgeon liable to be called upon to amputate without loss of time ought to have it at hand. The instruments necessary for dividing the parts should be placed on one tray, and on another, whatever is necessary for tying the vessels and dressing the stump; or, if both sets of objects are placed on the same tray, it should have a partition to separate one from the other. They should be covered over with a napkin or a piece of linen or cloth, that the patient, on whom their appearance might make a disagreeable or untoward impression, may not see them. And the surgeon or dresser who has to lay them out should recollect the precise number of them, because he can then, in a few moments, (the time necessary for counting them,) ascertain if the apparatus is complete. To be the more certain, however, he should not neglect to recapitulate the divers steps of the operation, taking up each instrument in the order in which it is required and putting it down again; the operator ought to do the same immediately before he begins the amputation, in order to guard against any omission, which might be of serious consequence. Dupuytren never neglected these precautions. The instruments which should be laid out for amputating may be enumerated as follows: 1. A tourniquet, although many surgeons dispense with it and with any similar instrument, substituting for it pressure made by the hand of an assistant. 2. Two or three amputating knives and catlings of various dimensions. 3. Two straight-edged bistouries or small knives, one pointed, and one blunt-edged, and one convex edged knife. 4. A retractor. 5. Two saws, one large with two or three extra blades; the other small and fine enough to cut off a small splinter of bone. 6. A pair of bone nippers. The most convenient amputating knives are those recommended by Lassus and adopted by Velpeau:

they are slightly convex on the edge, and having neither a prominent heel, nor too thin nor too blunt a point, will cut safely from one end to the other ; the handle should be sufficiently large to afford the hand a firm and easy grasp. The knives used by the old surgeons, and more especially the curved ones recommended by Wiseman, are unworthy of notice except as objects of curiosity. The bistouries should have fixed handles, or at least such as do not admit accidental motion. The best amputating saw is that invented by Dr. Fox of Derby. Its back is joined to the blade only at the extremities, and being moveable, may be inclined on either side so as to admit of the instrument being worked at the bottom of a hollow wound without the least chafing on the muscles or retractor. By this most useful improvement, Dr. Fox has rendered an important service to surgery. The next best saw to that of Dr. Fox is a common sash-saw rather widely set. Indeed, the surgeon should never use one that is not set sufficiently to work freely, or one that he is not accustomed to use. Every saw is an instrument with which a particular acquaintance is desirable on the part of the person who makes use of it. A joiner cannot work well if he has not his own favourite saw: how then can a surgeon expect to do so? Retractors of various kinds, and made of different materials, have been recommended. Some are made of leather. Baron Percy constructed one of metal which consists of two hemispherical plates, notched at the centre of the corresponding edges for the bone to pass through, and joined together by a hinge. But a large linen compress split for half its length, into one or two straps, according as the part to be amputated may have one or two bones, makes the best retractor, and is the only one now in use.

For tying the arteries and dressing the stump, there should be ready,—1. A good dissecting forceps, a tenaculum, a hook forceps, and two or three curved needles furnished with ligatures of different sizes. 2. Two or three fine sponges and warm water. 3. Straps of adhesive plaster, and a vessel containing boiling water, against the sides of which they may be warmed. 4. Two or more small pieces of linen in which to enclose the ends of the ligatures. 5. Lint, linen compresses, and two roller bandages, each two or three yards in length. The greased strips of linen, with which the French encircle the wound after the straps have been applied, and perhaps the lint used to form a pad to it, may be dispensed with, unless the latter be employed to keep the stump at a proper temperature; but for this purpose flannel or down is preferable.

The ligatures employed should be round, strong, and made of twine waxed, or of silk. They should vary in size, but it is desirable to have them of the least volume which will admit of their being drawn sufficiently tight. Silk ones therefore seem to be the best. The largest trunks of the limbs require only strong dentists' silk. Where an artery is unsound, however, I would recommend a large round twine ligature.

The large flat ligatures used by the French are objectionable : they do not grasp the artery well ; nor are they so well adapted as round ones to cut regularly through its internal and middle coat: they occasion suppuration in proportion to their size, and the large knot may prevent their coming away properly.

The straps of adhesive plaster should be from eight to ten or twelve inches long, and from three quarters of an inch to an inch and a half wide. They ought to be of recent preparation that they may stick easily. It is important to attend minutely to what is necessary for the dressing, in order that the patient may be put to bed without loss of time.

The number of assistants required for the operation varies according to the part to be amputated : one will be necessary to manage the circulation in the limb ; another will be required to draw up the skin and grasp the limb above the place of amputating; a third should hold that part of the limb which is to be removed ; and it will be well to have a fourth to hand the instruments to the operator, to apply the ligatures, and to hand up what is necessary for the dressing.

Measures necessary to prevent and regulate the loss of blood during Amputation.—During amputations performed nearer to the trunk than to the fingers or toes, the divided arteries in most cases would bleed enough to cause serious detriment to the patient, or even death, unless the flow of blood in them were considerably diminished. Perhaps it would be advisable, in many cases, to arrest the circulation in them completely ; but this is not practicable. There must be some loss of blood from the arteries ; but we have the means of rendering it compatible with the safety of the patient. Of these means, the ancients, generally speaking, had so inadequate a knowledge, that in the few amputations they dared to perform on living parts, the patient seems, according to Celsus and other writers, to have been in great danger of bleeding to death[1]. Peyrilhe, however, gave it as his opinion, that Archigenes was not only acquainted with the plan of guarding against too much bleeding during amputation, by tying a belt or bandage tightly round the limb which he wetted at the same time with cold water, but that he employed a ligature which he passed through the limb and tied so as to embrace, at once, its principal vascular trunks and the soft parts surrounding and covering them, before he began the operation.

Physiology teaches what ought to be done. The object to be attained is to prevent the arrival of more blood in the limb by the arteries than ought to be lost during the operation, without impeding the return by the veins, of that circulating in it at the time. This cannot be accomplished absolutely; because even the best means of preventing the arrival of blood by the arteries, impede more or less its return by the veins; but it can be accomplished to the degree necessary, and often so completely that the patient loses only a part of that blood which happens to be circulating in the limb at the time of the operation. The object can be best effected by pressure made with the fingers. Two or three fingers constitute a small instrument, which (as we have often heard Dupuytren exultingly say) possesses the immense superiority over all unliving instruments, of being endowed with the faculty of feeling, and which, therefore, can single out the principal artery of a limb, and press its tunics together so as to occlude its canal, without exercising much compression even on any venous vessel that may accompany it.

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[1] The expression of Celsus is, " Nam sæpe in ipso opere, vel profusione sanguinis, vel animæ defectione moriuntur."

The command of the circulation with the hand can only be intrusted to an assistant who understands it, and on whom the surgeon may depend. This assistant must place himself by the side of the operator, quite at his ease, and stand as if leisurely feeling the pulse of the artery at the part where it is to be compressed, ready to stop the circulation in it at a moment's notice. He should have examined the patient at some convenient opportunity prior to the operation, and ascertained the precise state and relative situation of the vessel on which he has to act, as well as the degree of pressure requisite to prevent the passage of blood through it.

Just at the instant the incision is about to be commenced, he is to compress the vessel to this degree; and in answer to the interrogatory look or word of the operator, to intimate that he has the circulation in the limb at his command. The pressure should be equal, and made perpendicularly to the plane on which the artery rests, but rather from than towards any accompanying vein. The hand exercising it should be in the most easy position, and so placed that the ends of the finger fall plump upon the vessel.

It will tire too soon if held in a cramped or uneasy position, or if too much force be employed. When the assistant feels fatigue, he can change hands without letting the artery escape, by sliding one down close upon the other. With these precautions, pressure may be kept up for hours[1]. An experienced assistant can exercise pressure for a very long time without fatigue, because he uses only the necessary degree of force, and takes care to hold himself and his hand in an easy posture. This is the plan of preventing hæmorrhage during amputation which is usually employed in the French hospitals, and which some English surgeons adopt[1].

Those who have never seen it tried will be agreeably surprised to find with what ease and certainty the passage of the blood may be completely stopped in a large artery by the fingers properly applied, provided the vessel rest upon something solid, as the femoral artery does on the os pubis, and the brachial artery on the upper third of the humerus. The great requisites are, to place the fingers directly over it, as when we feel the pulse at the wrist, to make the pressure perpendicularly to the resting-place, and to use a regular, and only the necessary degree of force. Much less force is necessary than would be supposed, *à priori*, as any person may discover by trying the experiment on a large artery in his own body, an experiment which teaches better than anything else how to enact the process.

It has been urged as an objection to this plan, that the artery is apt to escape from under the fingers; but if this happens, the fingers can follow it; and in this, we repeat, lies the paramount advantage of compressing with them, rather than with a pad of any kind; as we feel what we are doing, and can regulate the place, direction, and degree of pressure, as circumstances may require. It is true this plan cannot be adopted where the artery is not easily felt, or where lymphatic glands or hardened cellular tissue interpose between it and the fingers, or where it has no solid resting-place; nor can it be applied where the arterial distribution is so anormal as to preclude its employment: where, for instance, the limb is supplied by several large arteries, instead of one main trunk, as it happened in a case in which M. Richerand amputated the arm[2]. In all these cases the tourniquet must be used.

The other method, now in use, of suspending the circulation in a limb during amputation, consists in the exercise of pressure with a tourniquet. The principal precautions necessary in using it are, to select the proper part of the limb for its application, to place the pad directly over the region of the artery, to protect this and the opposite region with a linen compress twice or thrice folded, and to exercise only the necessary degree of pressure, which may be ascertained by feeling the arteries below the place of compression. It should be the exclusive care of one assistant to watch the instrument, and to attend to the circulation in the limb, during the operation. The tourniquet ought not to be applied until the surgeon is ready to begin his incisions: he should make it the last thing, so that the moment he has ascertained the instrument to be well fixed, and has confided it to the care of the assistant, he may begin the operation. To cause the blood to stagnate in the limb, as some surgeons do, by applying the tourniquet before they are ready to operate, can be of no use, but, on the contrary, must be injurious.

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[1] In a case where it was necessary to stop the passage of the blood in the femoral artery for several days without impeding its venous circulation or injuring the skin, Dupuytren employed several assistants, who effected the object in this way. They relieved each other in turns every three or four hours.

[1] A short time ago, one of the authors of this article took charge of the circulation in the abdominal limb, during an amputation of the leg, performed at the Derby Hospital by Mr. Wright. As it was the first time the plan had been tried in this institution, it excited considerable attention. The operator and the surgeons present seemed to think it preferable to pressure made with the tourniquet.

[2] Dictionnaire de Médecine.

Prior to the invention of this instrument, the single strap-belt for girding the limb, known, it appears, to Archigenes, and employed by Avicenna, Paré, and the old surgeons, had undergone some improvements of which the tourniquet may be considered the completion.

The French surgeons began their alterations by placing a pad under the belt, in the situation of the artery. To this, which was a decided improvement, Morel added two pieces of stick, which being passed under the belt, each on the opposite side of the limb, served to twist and tighten it. This addition, for the better constricting of the limb, he appears to have made during the siege of Besançon. Then came Petit's tourniquet, of which the one now in use is an improved modification.

Although by the present tourniquet the greatest pressure is made on the seat of the vessel, and on the opposite side of the limb; yet the constriction exercised all around it may interfere somewhat with the retraction of the muscles, and is certainly sufficient to impede the venous circulation, as may be seen after its application by the turgescence of the veins below it. This is an inconvenience not counterbalanced by the effect of the instrument in benumbing the limb, which Petit justly ascribed to it, but which, as we have stated, can be produced as well by the assistant who has to draw up the skin. It is also necessary to employ more force with the tourniquet than when pressure is made with the fingers; because the latter can cover precisely the region of the artery without extending beyond it, which the instrument cannot do.

It is also less advantageous than direct pressure, because it cannot, like the hand, be applied always at the upper part of the limb, out of the way of the operator.

Notwithstanding these disadvantages, which attach more or less to all instruments of the kind, the tourniquet answers the purpose sufficiently well to be employed with safety.

The compressor which Dupuytren has sometimes used for the cure of aneurism, and which consists of a semicircular piece of strong steel, sufficiently large to encircle the limb, with a pad at one end, and a handle moving a second pad at the other, would serve very well to compress an artery during amputation. It has the advantage of limiting the pressure to the opposite sides of the limb corresponding to the pads, but is somewhat objectionable, from being heavy. In case such an instrument as this, or the tourniquet could not be procured, the *garrot* proposed by Morel would be found a tolerably good substitute for them.

Knowing the principles on which the circulation of the limb ought to be regulated for amputation, the surgeon will generally be able to devise means for carrying them into effect under any circumstances. But whenever he has a good assistant, and the limb is supplied by the usual main artery easily felt and compressed on a solid resting-place, and he can therefore choose between direct, or (as it may be called) intelligent pressure exercised with the hand, and the blind compression made with an instrument, he will do well to prefer the former.

GENERAL METHODS OF AMPUTATING.

We shall now describe the plans of amputating which may be called *General Methods.* They are three in number, and are usually termed the Circular Method, the Oblique or Oval Method, and the Flap Amputation.

Circular method of amputating.—As its name indicates, this method consists in the division of the soft parts by a circular incision; that is, an incision made by carrying the knife once or several times completely round the limb, so as to cut them all through, from the skin to the bone. This division may be made by one, two, three, or more sweeps, or complete circular strokes of the knife.

A good amputation is that which is followed by a proper stump; and the knife ought to be applied a sufficient number of times to secure this result.

In dissecting what is considered a good stump, some years after amputation, we find the skin forming its surface united by its deep side to dense cellular tissue, in which are the ends of the muscles, fascia, nerves, and remains of vessels, all blended in one common cicatrix, in which the bone is sunk and imbedded. This cicatrix, which is of very firm structure, constitutes a proper cushion for sustaining whatever shock or friction the stump may be exposed to; and, being elastic, and left projecting beyond the bone, which it protects from all pressure, is admirably adapted to the purpose.

The end of such a stump, at least, for sometime after cicatrization, is decidedly concave, and represents a hollow cone, the sunk apex of which is formed by the bone, and the projecting base by the integuments. The depth of this cone should be such, that all the weight the stump may have to bear shall press on the soft parts only, and not on the end of the bone. This depth may, therefore, vary a little according to the volume and structure of the limb, and the uses required of the stump.

The slightest reference to the anatomy of the limbs shows that a good stump, of this shape, can only be secured by dividing certain layers, more or less definite, in which the soft parts present themselves in the limbs, so as to leave them of different lengths. From the anatomical structure of these layers, the moment they are divided they shorten to different degrees, but all more or less by the effect of their own contractility ; so that the surface of the stump is not at the place, taken on the bone, where they are divided, but at the place to which they retract, or at which their cut ends remain after they have retracted. For example : a muscle covering, from its upper end to the place where it is to be divided, twelve inches of bone, will cover much less (say nine or ten) after its division. Inasmuch, then, as the layers shorten to different degrees, and must have different lengths after shortening, (the superficial or cutaneous one requiring to be left long enough to wrap over the cut ends of all the others, as well as the bone) it is absolutely necessary, for the formation of a good stump, to divide them layer by layer, and to make at least as many circular incisions as there are distinct layers[1]. If the different layers were of a nature to retract exactly to the same degree, and required to be of the same length after their retraction, one circular incision would be sufficient to divide them ; it would be necessary to wind the knife only once round the limb, and to cut through them all, from the skin to the bone, at one sweep. But as they require to be left of different lengths, and as they are not retractile to the same degree, each layer must be cut through separately.

In determining, then, how the section of the soft parts should be made, we must be guided by the number of layers it is necessary to distinguish in them, by the degree to which each will retract on being divided, and by the length each ought to preserve after retraction.

In general, three layers require to be distinguished : the skin and subcutaneous cellular tissue form one ; the muscles, not attached to the bone near the place of amputation, constitute the second ; and those which are so attached make the third[2].

The skin with its cellular tissue retracts, of itself, but little; so that the quantity of this membrane required to form the surface of the stump will indicate, pretty nearly, the place at which it should be divided. It ought always to be left rather full than scanty. Perhaps a better general rule cannot be given than to leave it longer than the bone, by half that diameter of the limb to which the line of cicatrix is to be perpendicular. Muscles retract according to the length of their fibres, measured from the place of their attachment to that where they are to be cut through : the greater this length, the more they retract. The first, or superficial layer of muscles being composed of those of the longest fibres, retract much more than the second or deep layer. But as the muscular structure is somewhat different in this respect, in the thoracic and abdominal limbs, and in various parts of the same limb, precise directions can only be given as to the place where the layers should be divided, in the description of each particular amputation. We may premise, however, that the superficial layer must be cut through much farther from the trunk than the deep one, and that the surgeon should always take as a guide the anatomy of the muscles he has to deal with.

If the muscles are left of such length that by closing the wound, those of one side can be easily made to meet those of the other side of the limb, between the end of the bone and the skin, they will be of the proper length for the formation of a good stump ; and, although there are many amputations in which this rule cannot be strictly followed, it should always be the aim of the surgeon to adhere to it as closely as possible. The quantity of integuments preserved should vary somewhat according to their state of tonicity; a fourth or fifth less will be required when they are flabby than when firm and elastic. The same remark applies, in some measure, although less strictly, to the muscles.

By whatever incisions the parts are divided, they should be cut through, so that the entire section shall be perpendicular to the longitudinal axis of the limb ; otherwise, the weight the stump may have to bear would not be equally distributed, but press unduly on whatever part projected beyond the level.

We shall now describe the different plans that have been proposed for performing amputation by the circular method, beginning with that generally adopted at the present time.

Modern plan.—The plan approved by a great number—probably the great majority—of our contemporaries, is that most in conformity with what has just been stated regarding the order and manner in which the parts should be divided. It may be described as follows :—

When the surgeon has ascertained that all is ready, that the instruments are at hand, that the circulation is well attended to, and that the patient and assistants are properly placed, he should direct one of the latter to grasp the limb with both hands firmly, about a hand's breadth above the place where he intends to make his first incision, and another to support steadily the part about to be removed. Both these assistants, especially the latter, should place themselves in an easy posture, so that they can support the limb steadily during the whole time of the operation. Standing on the right or left of the patient, according to the part to be amputated, the operator should place himself in such an attitude, as to be able to stoop and rise steadily, by bending and extending himself without moving his feet. To perform the operation dexterously, he must not be moving about, or placed in an awkward position. Holding the knife (which is to be handed to him by an assistant) as he would hold a sword[1], and grasping it firmly, he is to pass his hand and arm under the limb, so as to encircle it, and bring the edge of the knife fairly upon its anterior region. Here he begins to cut, and by winding his arm round back again, he brings the edge of the knife with equal and moderate pressure over every point of the circumference of the limb, and divides the skin and cellular tissue down to the fascia, by one complete circular incision, made to terminate exactly where it commenced. In this, and in all incisions made round a limb, the knife must not be depended upon to cut solely by pressure, or by motion in one direction, but by a sawing motion to and fro, communicated to it whenever necessary.

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[1] Alanson's ingenious device for effecting the desired object by one incision is not practicable.

[2] Authors usually employ the terms "superficial" and "deep" to distinguish the two layers of muscles; but these do not give a sufficiently exact notion of what is meant.

Very little pressure is required, or ought to be made on the instrument; the degree necessary should be measured and appreciated by the depth of parts to be divided at the commencement of the incision which on that account is to be begun slowly, and continued cautiously, the eye always preceding and directing the hand. When the entire circle cannot easily be gone over by one incision, it should be completed by a second, made by re-applying the knife, and drawing it in a contrary direction, from the beginning to the termination of the first. Some surgeons always make the circle in this way—by two incisions; because, as they justly affirm, it can be made more easily, more safely, and perhaps more rapidly than by one.

Immediately after the first incision, the skin, with its cellular tissue, is to be drawn up to the necessary extent, by the assistant aided by the operator who is to detach it from the aponeurosis with the end of his knife, or with a large probe-ended bistoury, and if much be required, to turn it back like the end of a sleeve[2].

Half an inch below the place to which the edge or fold of the skin has been drawn, the surgeon is to divide the fascia and all the muscles down to the bone, by an annular incision, made by one or two sweeps of the knife, in the same manner as that for dividing the integuments. This incision, although carried at once through all the muscles, is final only for the superficial layer. It is made through them all, in order to insure, beyond the possibility of escape, the complete and equal division of those constituting this first layer, and which otherwise might not be all cut through; because their thickness cannot be estimated beforehand, with exactness sufficient to indicate the degree of action of the knife necessary to divide them, and them only. It serves to divide, to a positive certainty, all the superficial muscles, and to distinguish them from the deep ones; which last, retracting less, and requiring to be left shorter than the superficial layer, must be divided by another incision. The separation between the two layers is effected at once; for, as soon as the incision is made, the muscles composing the first or superficial one retract, and leave the others, which retract less, projecting beyond them, and forming with the bone the central part of a cone, placed inversely to that which the stump itself ultimately represents.

At the base of this cone, on a level with the retracted ends of the superficial layer of muscles, the operator must again apply the knife, and, by a third circle of incision, divide the deep ones.

With a small knife he is now to detach from the periosteum the fibres immediately surrounding it, conformably to the excellent precept of Celsus: in fact, to dissect up to the extent of an inch, more or less, round the bone, which, when sawn through, will thus have its end covered and protected, even by these, and remain imbedded in them as before the operation. This is a very important part of the operation; for if these fibres or the periosteum are detached further than the section can be made with the saw, the denuded end of the bone must exfoliate and disturb the cure. The retractor must be carefully placed close under these fibres, so that the bone may be sawn through, up to the very highest which has been detached, and not left devoid of muscular attachment even to the extent of a hair's breadth: as thus, and thus only, can we be sure of protecting it from all necrosis, as well as of giving it the disposition which will best conduce to the formation of a good cicatrix. The surgeon is to place the retractor so that the bone lies at the bottom of the slit which divides half its length into two straps. With these straps crossed in front of the bone, and the other half of the retractor placed posteriorly, an assistant is to support the soft parts and protect them from the action of the saw.

To cut through the bone, the surgeon is to place his thumb-nail fixedly on it, close against the retractor, and then adjusting the saw at its heel to his nail, which serves to guide it, to set in, or make a track by drawing it steadily backwards, with scarcely any other pressure than that of its own weight. He continues to saw by moving the instrument held lightly in his hand, perpendicularly to the axis of the limb, to and fro, in strokes always steady and gentle, but becoming more so, and accompanied by less pressure, as he approaches the completion of the section; so that there may be no danger of splintering the bone[1]. During this part of the operation, the assistant, who holds the parts to be removed, should do nothing more than bear the weight of it in his hands, one of which should be placed near the saw. The least motion of the limb would interfere with the action of this instrument, or snap the bone. He must therefore watch the action of the saw, and not look at the operator; for so sure as he does, or is told by him to move the part in any direction, the saw will be nipped, or the bone splintered: so slight a motion will do one or the other, that nothing ought to guide the assistant but his own judgment. Although the necessity of this precaution seems so obvious as hardly to need mention; yet, for want of attention to it, the bone is often splintered. If the saw happened to be nipped, the surgeon would say "lower the part," and the assistant looking at him and not at the saw, obeying the word instead of attending to his own sensations, would indeed lower the part, but snap the bone. If the surgeon interfere at all with the position of the limb, he had much better do it with his hand which has hold of the bone, than by giving any direction to the assistant. When the precautions we have recommended are neglected, and the bone is splintered, the surgeon must remove any irregular projections, or roughness it may present, with a very fine saw, or with a pair of bone-nippers, so as to leave its end perfectly smooth. It has been recommended to ease off the sharp margin of this end by scraping it with a knife or file; but besides that nature does this afterwards much better than art can do it, to scrape the edge of a bone is to denude it, and necessarily to cause it to exfoliate. When the bone is sawn through, and its end on the stump left with a clean smooth surface, the amputation is finished.

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[1] When the knife is held between the fingers and thumb, and not grasped in the hand, the surgeon has not the same, nor even sufficient power over it.

[2] The origin of this practice of turning back the skin is attributed to Alanson.

[1] To use the saw well requires a good deal of practice. Every surgeon should know that the art of sawing does not come of itself, and can only be acquired by practice. We say this the more earnestly, because it is somewhat rare to see an operator use the saw properly. Good joiners seldom or ever splinter the most delicate piece of wood; but surgeons are

Such is the plan of performing the circular amputation generally adopted at the present day. We have now to describe and compare with this plan, and with each other, the other plans of executing it, which surgeons have from time to time proposed.

Plan of Celsus.—The soft parts are to be divided down to the bone, and then dissected off and drawn back, so as to leave some part of it bare. The bone is to be sawn through as near as possible to the sound flesh adhering to it, eased off in front, where the saw may have made it rough, and then to be covered with the skin, of which a sufficient quantity should be preserved, to close it over to the greatest possible extent.

Plan of Wiseman and Paré.—The plan of Wiseman, who appears to have operated in the same manner as Paré had done before him, may be gathered from the following quotations from his work:—

"The member is to be supported by some one, whilst another standeth behind the patient and draweth up the skin and musculous flesh. Then make your ligature two fingers' breadth, or thereabouts, in the same parts.

"This ligature made, the assistant strengthens it whilst he draws up the musculous flesh. In the mean time, the operator, with a sharp crooked knife, by a turn with his hand, cuts the flesh off around the bone; then with the back of it he scrapes the periosteum from the bone; if there be two bones, then, with a dividing knife, he separates the fleshy membrane from them. The bones freed from the periosteum, Guido proposes a linen cloth, and Hildanus a kind of purse, to be brought over the upper divided flesh, to pull it upward and make more way for the saw. But I think that needless. The flesh divided, the parts separate of themselves; besides, the assistant's pulling up the musculous flesh is sufficient. That done, you are at liberty, whether you will cauterize the vessels by a button cautery, or, by ligature, stop the bleeding, or by agglutination."

Plan of Cheselden and Petit.—After stating, that when the parts are flaccid they should be tightened by two ligatures, applied round the limb—one above, the other below the place at which it is intended to amputate, Petit describes his operation in the following manner:—he says, "It has ever been considered an essential point in amputations, to preserve a good deal of soft parts, and to bring them together, in order that the bone may be more speedily covered, and the cure hastened. It was with this view I conceived the plan of cutting them through by two circular incisions. I begin the first an inch below the place where I intend to saw through the bone, and by it divide only the skin and fat down to the aponeurosis. I have the integuments drawn up, so as to uncover, for more than an inch, the muscles beneath them. These I divide by the second incision, and draw them back with a retractor; and thus the bone, after it has been sawn through, is left sunk in the midst of them."

Plan of Benjamin Bell.—The directions given by this excellent surgeon, are, first to divide the skin by one circular incision, and to preserve enough of it to cover the surface of the stump; in the second place, to divide the muscles down to the bone by another incision; and, thirdly, to dissect up round the bone, so as to be able to saw it off considerably above the cut ends of the muscles.

Alanson's Plan.—As there has been considerable difference of opinion with respect to the exact manner in which Alanson operated, we shall give his own description of it. In his Practical Observations on Amputation, page 33, he states, "I shall now bring into one view our established mode of performing the operation of amputation on the thigh, and the after treatment, as practised in the Liverpool Infirmary. Apply the tourniquet as usual, and let an assistant draw up the skin and muscles by firmly grasping the limb with both hands. The operator then makes the circular incision as quick as possible, through the skin and membrana adiposa down to the muscles; he next

constantly splintering bones in the living body. The reason of this difference is obvious; the former have learnt to saw—the latter have not.

separates the cellular and membranous attachments with the edge of the knife, till as much skin is drawn back, as will afterwards cover the surface of the stump with the most perfect ease. The assistant still firmly supporting the parts as before, apply the edge of your knife under the edge of the retracted integuments, and cut obliquely through the muscles, upwards as to the limb, and down to the bone; or, in other words, cut in such a direction as to lay the bone bare, about two or three fingers' breadth higher than is usually done by the common perpendicular incision; and continue to divide or dig out the muscles all round the limb, by guiding the knife in the same direction. The part where the bone is to be laid bare, whether two, three, or four fingers' breadth higher than the edge of the retracted integuments, or, in other words, the quantity of muscular substance to be digged out, in making the double incision, must be regulated by considering the length of the limb and the quantity of skin that has been previously saved by dividing the membranous attachments. The quantity of skin saved, and muscular substance taken out, must be in such exact proportion to each other, as that by a removal of both, the whole surface of the wound will afterwards be easily covered, and the length of the limb not more shortened than is necessary to obtain this end. The bone, being now laid bare all round, is to be divided as usual with the saw, and as high up as possible, which will be more easily executed if the retractor, recommended by Gooch and Bromfield, is first applied for the support and defence of the soft parts."

Plan of Ledran and Louis.—This plan of amputating, as applied to the thigh, is thus described:—You are to begin by making a deep incision, which is to divide at once the skin and muscles, at the distance of three fingers' breadth below the place where it is intended to saw through the bone. This done; the ligature employed to keep back and tighten the skin is to be removed, and the muscles thus liberated, will immediately retract and take new positions. You are to keep back the flesh with a split compress or retractor, and then to divide, with a bistouri, the rectus, the vasti, and the adductors, at their attachment to the linea aspera of the femur. By this method the bone may be divided three fingers' breadth higher than when it is cut through on a level with the muscles bound down by the ligature.

Plan of Dessault.—Although the plan of amputating we have described as being that of the moderns, is claimed by the French, as the invention of Dessault, a doubt may be fairly entertained, whether his operation exactly corresponds to the modern plan. We shall therefore briefly describe it apart. Bichat distinctly states, that Dessault performed the operation "*à trois tems.*"

According to this author, he first divided the skin and had it drawn back by an assistant, whom he aided, by detaching it from the aponeurosis with the point of the knife. He next divided all the muscles down to the bone, opposite the margin of the retracted skin; and thirdly, when those of the superficial layer had retracted, opposite their retracted ends, he cut again through the deep ones, and then sawed through the bone.

Plan of Dupuytren.—The skin being drawn back tight by an assistant, who grasps the limb, the operator is to divide the soft parts down to the bone, by one sweep of the knife. The superficial muscles with the skin will then retract, and leaving the deep ones prominent, give to the stump the shape of a cone having its base towards the body. Upon this base, opposite the ends of the retracted muscles, another circular incision is to be made, to divide a second time those adhering to the bone; and, as long as any of these remain projecting, they are to be divided at the base of the cone they represent, by successive incisions, while the rest of the soft parts are held back by the assistant.

The bone may be thus denuded to the extent of more than six inches. The operator is to dissect round it, and make a track for the saw, (by which he will lay it bare still higher,) and after placing the retractor, to saw it off close to the fibres adhering to it[1].

We shall now offer a few remarks on the comparative advantages and inconveniences of the different plans of performing the circular amputations we have just described, in order to set forth their respective value.

The plan adopted by Paré and Wiseman is generally considered as that of Celsus; but it cannot be considered so good as the latter, because it omits to prescribe the detaching or dissecting off the fibres immediately surrounding the bone. The additional precaution it includes of the application of a ligature round the limb does not compensate for this omission. Petit's plan of amputating,—the first devised after that of Celsus which will bear comparison with his, ensures,—by the double incision, (as the separate division of the integuments and muscles is called), the preservation of a sufficient quantity of skin to form a covering to the stump. This constitutes its distinguishing character and chief excellence, and makes it far superior to the plan of Celsus. But however great and unquestionable this superiority, it is diminished by the omission of the important precept of Celsus, to dissect off the fibres which immediately surround the bone, before it is sawn through. At the same time, it ought to be mentioned, in justice to Petit, that, in speaking of the amputation of the leg, he distinctly directs the fibres attached to the bone in the interosseous space to be dissected off and preserved, although he appears to do so principally that they may form a safe lodgment for the vessels.

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[1] Velpeau has committed an error in attributing to Dupuytren another plan of amputating, which he has described in his Chirurgie Opératoire. From long personal observation, I can affirm that the plan of this celebrated surgeon is the one described as his.

Perhaps he was accustomed to adopt the precept of Celsus in amputating, although it does not appear in the description he gives of this general plan; and we are the more inclined to believe this to have been the case, because the same thing has happened to other authors, with respect to this very precept; deeming it perhaps a matter of course that it would be made, as it ought to be, part of every plan of amputating.

Making the first incision entirely subservient to the division and preservation of the skin was so important an improvement on the plan of Celsus, that it is difficult to believe that he who invented it could overlook the advantage of dissecting up round the bone, so as to preserve for its defence the fibres immediately attached to it. Still it does often happen that the mind achieves an invention without carrying with it the discoveries which had preceded it: and this is much to be regretted; for the plan most likely to effect the object of every one desirous of contributing to the advancement of science, is that he should take all that has been done by his predecessors and contemporaries, and then see if he can add anything valuable of his own. If Petit and Cheselden had included among their precepts that of Celsus, to dissect up round the bone before sawing it through, their plan would have been nearly as good as any that has since been devised.

Benjamin Bell positively adopted this precept, which he combined with the plan of Petit and Cheselden; and thus became the author of a better operation than their's. Bell's plan unites the two essential conditions of a good amputation, the preservation of skin to cover the stump, and the preservation of muscular fibres to protect the end of the bone. It is, therefore, inferior to none, except the modern plan, and to that only in a slight degree.

The object aimed at by Alanson, namely, to preserve sufficient skin to cover the surface of the stump, and to leave the bone sunk and well defended in the muscles, is that sought to be accomplished in the modern plan of amputating, which is decidedly the best; and though he takes the proper measure for attaining it in his mode of dividing and preserving the skin, he falls short of it in the manner in which he directs the section of the muscles to be made. Indeed, it is impossible to follow the direction he gives for dividing the muscles; and if it were possible, their cut ends would not form a hollow cone as he states, at least not for a moment beyond the time of their division; for, the superficial ones would retract so much, that the cone formed would be very irregular, and perhaps inverted, immediately after their retraction.

To allow for this retraction, the section would require such an obliquity, that it cannot be made by one sweep of the knife, unless the instrument is used as a scoop, its point resting on and describing the circumference of the bone, while the part of its blade corresponding to the circumference of the limb describes the latter. To cut through the muscles of a small limb at all obliquely upwards towards the bone is extremely difficult, and to make the section sufficiently oblique, quite impossible by one sweep of the knife, as Alanson proposes.

Upon the whole, the plan of Alanson may be said to be far inferior to that of Bell, and scarcely equal to that of Petit; because, although as regards the division of the skin, he proceeds in the same manner as these authors, his mode of dividing the muscles is not so good as theirs.

The plan of Louis is intended to obviate the unequal retraction of the superficial and deep muscles, by the division of the deep layer by a separate incision after the section and consequent retraction of the superficial one. Unfortunately, however, Louis directed that the latter and the skin should be divided together. This plan differs scarcely at all from that of Celsus. Louis himself remarks, that it is rather the revival of the plan of Celsus than a new one of his own which he recommends; and, in fact, the only difference between the two appears to be, that Louis drew back and tightened the skin by means of a ligature applied round the limb, and divided by his first incision a greater thickness of muscles than Celsus.

We observe in Louis the same unfortunate reluctance we have before noticed in surgeons, to adopt in their own plans what is good in those of their immediate predecessors. Louis not only overlooked the necessity of dividing the skin first, and making sure of a sufficient quantity of it to cover the surface of the stump, but took great pains to show that the preservation of a little too much skin is a great disadvantage.

But experience has demonstrated that the preservation of the skin, as directed by Petit, is of so much importance as to establish at once the great superiority of his method over that of Louis. The merit of Louis, in what concerns amputation, lies in the accuracy of his views with respect to the manner in which the muscles retract and influence the shape of the stump; and if, as there is reason to believe, his views led to the modern mode of dividing the muscles by layers, founded upon the law of their retraction, in order to do him justice, we have only to transfer our praise from the operator to the physiologist. It is also right to notice that Louis admitted the propriety of a separate incision for preserving the skin in amputations of the forearm and leg. It was for the arm, and more especially for the thigh, that he recommended the plan which bears his name.

Dupuytren, by a strange and inexplicable fatality, operated like Louis in dividing the skin and muscles together. He differed from him in making more incisions of the latter, and in having the skin drawn tight and fixed by the hands of an assistant, instead of employing a ligature.

His incisions were made with such velocity, that the eye could scarcely follow them; and to superficial observers, to those who were mere spectators, his amputations appeared splendid. The dexterity of the operator excited their admiration. But in myself, who assisted Dupuytren in these operations, the admiration was mingled with regret. I had to watch and dress the patients, and I could not shut my eyes to the evil results. The stumps were often conical in the wrong sense; sometimes even the bone was salient and afterwards exfoliated. Those who witnessed the operation only, went away with the notion that Dupuytren's amputations were equal to his other operations, almost all of which were excellent. This was unfortunate; for had it been otherwise, the general opinion of the profession would have been against his plan, and he might have been induced to alter it. His great fault lay in not devoting his first incision entirely to the division and preservation of the integuments. This he either did not see, or thought he could counteract by preserving an additional quantity of muscle; for he was aware that his stumps were often faulty; and I have frequently seen him make more than three sections of the muscles, and also dissect up round the bone, whispering as he proceeded, "Surely I shall preserve soft parts enough here!" as if determined to secure a good stump.

He had placed the originality of his plan of amputating, as a modern one, in cutting at once to the bone, as directed by Celsus. He was careful, as I have stated, to adopt the precept of this author to dissect off and preserve the fibres immediately attached to it. So far his operation was exactly that of Celsus. He really differed from him only in dividing the deep muscles over and over again, as long as any of their fibres remained projecting. I never could discover any valid reason why he adhered to so bad a plan of performing amputation. He was, undoubtedly, so much accustomed to perform operations upon plans of his own superior to those of his contemporaries, that to operate as they did was to depart from a long-contracted habit; but it is much to be regretted that he did not imitate them in adopting the modern plan of amputating, which justice obliges us to confess is immeasurably superior to his.

From the foregoing examination, we think no surgeon can hesitate in giving the preference to the modern plan of performing the circular amputation, and a reference to the changes which the parts forming the stump or the remaining part of the limb undergo after amputation must strengthen his conviction of its superiority. It must be evident to every physiologist, that it is the only one which prevents the bone ever being prominent, and ensures the division of the parts, so that the surface of the stump shall represent a hollow cone. The more amputations we see, the more shall we be impressed with this truth. And it is one of so much importance, that we hope our friend M. Velpeau will see reason to reconsider his assertion, that the same result may be obtained by whatever method the circular amputation is performed. It may, perchance, be obtained in some few instances where the limb is small and circumstances are favourable; but whoever would guard against the serious and often irremediable mischief of a sugar-loaf stump, must adhere strictly and carefully to the modern plan. To preserve skin enough to cover fairly the whole surface of the stump without any stretching of this membrane; to divide the muscles layer by layer, so that after retracting, those nearest the skin are left the longest, and those next the bone the shortest, and that there is, as far as possible, a regular slope from the former to the latter; to divide the bone so that no portion in the stump be left uncovered by muscular fibre; such are the great objects to be aimed at in the circular amputation, and which, we repeat, can be accomplished only by the modern plan of operating.

The surgeon, therefore, cannot be too careful in determining at what point the bone ought to be divided before he begins his incision.

The method of amputating by Flap consists in the formation of one or more flaps, out of the soft parts, with a view to the immediate covering of the stump, and the more speedy cicatrization of the wound. Although Sprengel and Gagnier seem to refer the origin of this method to Celsus; and Velpeau considers that it is described with tolerable clearness by Leonides and Heliodorus, it is nevertheless certain, that a plain and satisfactory description of it was first given by an English writer, J. Yonge, at the end of a dissertation, entitled, "*Currus Triumphalis e Terebintho*," which he published in 1679. Yonge states that this method of amputating originated with N. Lowdham, a surgeon at Oxford, and to him, unquestionably, the honour of this improvement belongs; but it is only proper to observe, that such a proposal must have naturally suggested itself as soon as surgeons began to be aware that the scaling and exfoliation of bone did not of necessity form a preliminary step towards the healing process. Amputation by flap encountered some opposition from Kœnerding, and was only resorted to, at first, in cases of amputation below the knee, and in general only a single flap was formed. Emboldened by success, the surgeons in the following century extended it to the amputation of the fore-arm, and subsequently to that of the arm, and even of the thigh.

In 1696, Verduyn of Amsterdam proposed a modification of it, to which he ascribed advantages, now known to be illusory; he imagined that the compression of the vessels of the flap against the extremity of the bone would suffice to prevent hæmorrhage.

Sabourin, of Geneva, in 1702, addressed a memoir on the subject to the French Academy, without, however, producing any other than a mere momentary impression in its favour.

When its application was extended to the amputation of the thigh by Ravaton and Vermale, the simplicity of the manner in which it used to be performed was effectually destroyed by the former. He described his plan to the French Academy in 1739; his first incision, which he made with a crooked knife, was circular, and went to the bone ; he then made two other incisions, perpendicular to the first, one at the fore part, the other at the back part of the limb, avoiding the principal vessels, until the flaps were detached from the bone, to the extent of four fingers' breadth above the first circular incision.

In the flap method the operator forms one or two flaps, seldom more ; the incisions being directed from without, inwards, or from within, outwards. In the former, which is Langenbeck's mode, the knife proceeds ascending the limb obliquely, from the skin to the bone: in the latter, which is Vermale's, the knife is passed through the thick of the limb, grazing the bone, at the point where it is to be sawed, until its point appears through the skin, at the opposite side; it is then carried in an oblique direction, cutting downwards and outwards, from the root of the flap to its free margin. The performance of the operation by this mode may be rendered very brilliant and rapid, and is, therefore, in general preferred, but it is not so even and regular as the former. The knife employed should be long, thin, and finely pointed,—it may be double or single edged ; in certain cases, however, the double edge is indispensable. The flap or flaps should be so formed that the large vessels shall correspond to their thickest part, being thus of course remote from the angle of junction of the incisions, and, in general, the flap in which the principal vessel is included, should be formed last; this rule, however, admits of some exceptions, which shall be noticed at the proper place. When a flap amputation is performed in the contiguity, the member is disarticulated before the second flap is formed. When this mode of operating is resorted to, in the continuity of the limb, the bone is sawed in the usual way.

On the first introduction of the method of operating by flap, its partisans assumed for it a superiority over the circular mode, on the ground of its being less painful, of more prompt execution, preventing exfoliation of the extremity of the bone, exposing but rarely to hæmorrhage, requiring no ligature of vessels, effecting a cure more speedily, and forming a better stump. Time, however, has shown how much these pretensions were exaggerated. Most surgeons now agree, that the stump is less likely to be conical than when the circular method is adopted ; that the flap amputation is more rapid of execution, and covers the bone better ; that the flaps may be more easily and accurately adjusted, especially in deep and extensive wounds ; and probably that their reunion is more speedy and certain.

The advantages of this method, as regards the rapidity of reunion, would doubtless have entitled it to a larger share of favour, had not the progressive improvement of the circular method rendered union by first intention, in the cases in which it is employed, almost equally certain. It is better to form two flaps than one, when both can be made of equal thickness and width, as in that case the bleeding surfaces are brought together with the most perfect ease. When a single flap only is formed, it must be often extremely long, and when not sufficiently so, it becomes necessary to stretch it over the sawed extremity of the bone. This was Verduyn's method, and its inconveniences are so obvious that it is but seldom preferred. Unfortunately, however, it is sometimes the only method that can be resorted to, as, for example, on the field of battle, when one side of a limb is either carried away, or disorganized by a cannon-shot ; in other cases also, its adoption is often less an affair of choice than of necessity. The motives for preferring it in certain cases will be discussed under the particular amputations.

One of the great advantages of this method, when first introduced, was the effect it had in familiarizing the minds of surgeons to the healing of the wound by first intention. But even on this point, it would appear, that their opinions were far from being firmly established, for we find, in 1765, Sylvester O'Halloran, of Limerick, proposing to renounce this important advantage, and recommending that the flap should not be applied over the bone, until such time as it should be covered with granulations.

The oblique, or oval method, consists in such a division of the soft parts, as will represent a V ; each flap will thus have the form of the mouth-piece of a lute. It is simply a modification of the flap amputation, adapted to particular cases. Langenbeck first employed it in the amputation of the metacarpal and metatarsal bones ; it was subsequently employed by Mr. Guthrie, in that of the shoulder-joint, and it has since been strongly recommended by Scoutettin, in other situations.

The V may be formed by two incisions, which shall divide at once the integuments and muscles down to the bone, the angle of union of these incisions being upwards, or in the direction of the trunk. In some cases, the skin alone is divided in the first cuts ; it is then retracted, and the muscles are divided down to the bone. The division of the skin and muscles by separate cuts, is considered preferable, wherever the soft parts are voluminous.

The cases in which the oval method may deserve a preference will be pointed out in the particular amputations.

Measures necessary to arrest the bleeding after amputation.—These require as much attention, and perhaps more skill, than the cutting part of the operation. Dionis remarks, "le plus difficile n'est pas d'abattre une jambe, un boucher en feroit bien autant; mais c'est de se rendre maitre du sang en l'arrêtant avec promptitude et avec sureté."—It certainly is more easy to amputate a limb than to stop the bleeding afterwards; and yet how little care has been taken to impress the young surgeon with a sense of the difficulty and importance of this part of his duty. Here, a keen eye, a practised hand, and minute anatomical knowledge are especially necessary. As soon as the amputation is over and the retractor removed, the soft parts of the stump are seen tending to recede from the end of the bone. The vessels shorten somewhat after their division; they generally lie more or less concealed in the interstices of the muscles, and are not very apparent on the surface of the wound. The nerves, which shorten less, are more prominent objects upon it. The muscles are found to have retracted more or less according to the length of their fibres, and to have drawn up in their sheaths the tendons belonging to them.

The arteries are to be tied without delay; and the surgeon should secure the principal branches in the order of their volume and known position. He will do well in searching for the others, to proceed from the bone towards the skin. By this order he will save much time, and no inconsiderable quantity of blood. The ligature is the means adopted, almost without exception, now a-days, to arrest the bleeding after amputations. The principles on which its application is founded, are developed in the Articles Ligature, Aneurism, and Hæmorrhage. (See these Articles.)

The ligatures should be round, and not larger than is required to admit of being tied tight enough to divide the internal and middle coats of the arteries without danger of breaking. Those made of inkle or silk are usually employed. It will be well for the surgeon to be aided by two assistants in securing the arteries, one to apply the ligatures, the other to hold the stump in a convenient position between his two hands, which are gently to grasp and support it. He is himself to take up the arteries, and should stand or sit quite at his ease, so as to be able to use both hands rapidly yet steadily. In the left he will hold a sponge moistened with hot water to wipe the blood from the end of the stump; in the right a forceps or tenaculum. The former is better suited for the larger, the latter for the smaller vessels. In using the forceps he is to place its branches on opposite sides of the artery, and to lay hold of it by bringing them together. With the tenaculum he is to seize it by hooking it through. Where, from the smallness of the vessel, or from its situation, it cannot readily be secured, he is to mark the spot whence the blood issues, as he wipes it away, and at that spot to lay hold of it, the instant he uplifts the sponge, and before a fresh gush of blood conceals it. When seized, the artery is to be slightly drawn out from the surface of the wound; and if the surgeon perceives he has taken anything with it, he must isolate it by transfixing it with a tenaculum behind the instrument retaining it. The assistant isolating it, is to tie it immediately behind the instrument, as he would tie up the mouth of any yielding tube. Having made the knot, at first loosely, he is to tighten it by drawing steadily on the ligature wound round the last three fingers of his hands, while his thumbs, or index fingers, serving as pulleys, direct it to the exact place where it is to embrace the vessel, but always rather away from the instrument, lest it slip off.

If a forceps is used, the noose may be first made on it and then slipped over its end on to the artery, to be there tightened. When the coats of the vessel, after gradually yielding to the pressure of the ligature, cease to give way, we may be sure the internal and middle ones are divided, and that the knot is sufficiently tight. By this the proper degree of force can always be estimated. As the ligature should be fastened by what is called a *right knot*, a second knot is to be made over the first, and care must be taken to let nothing interpose between the two[1]. Sometimes there is great difficulty in securing an artery owing to its being situated in an excavation or among tissues which conceal it and facilitate its retraction, such as aponeurotic textures[2]. In this case, if it cannot be seized with Assilini's forceps, a ligature, which is to embrace with it some immediately surrounding tissues, but as little of them as possible, may be passed round it by means of a curved needle. Such a ligature should be very strong, as considerable force may be necessary to tighten it; and if not drawn sufficiently tight to cause the sloughing of the tissues, which it includes, it might be retained by them and thus retard the cicatrization of the wound. The disadvantage of securing an artery thus mediately is in relation to its volume, because the larger the vessel the more uncertain is its obliteration by this kind of ligature; and the more likely is it to be accompanied by veins and nerves which it were well to exclude, but which cannot be excluded from it. The inconvenience of tying small arteries mediately is not very great, and many surgeons in taking them up do not make a point of isolating them with nicety.

All the arteries are to be secured which, on the tourniquet being removed, furnish blood in a distinct jet or stream, however small. The surgeon may know he has tied all those which require a ligature, when, after cleaning the stump with a sponge, he finds the blood is not renewed in sufficient quantity to prevent the uniting of any part of the wound by first intention. It is better to tie too many than too few, especially as some which from retracting or some other cause, furnish no blood for a short period from the completion of the operation, are sometimes apt to bleed afterwards; and the fewer there are taken up, the more firm and compressive must be the dressing applied to the stump. In general, the French surgeons tie more than it is customary to secure in this country, and in my opinion, more than is absolutely requisite: it is, however, erring on the safe side.

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[1] I once saw the application of a ligature to the external iliac considerably retarded by the interposition of something between the two knots. The surgeon thought it right on that account, to tie the vessel a second time.

[2] M. Ribes thinks the degree to which the anterior tibial artery retracts after division is owing to the manner in which it traverses the upper part of the interosseous ligament.

The precise number of arteries which it may be proper to tie cannot be foretold with exactness; that must depend on their volume, number, and disposition to bleed in the part, and, in these respects, they are not often the same in the same parts. The difference is sometimes very great, and may belong to a peculiar condition of the limb, induced or not by the disease which rendered amputation necessary. After an amputation performed by M. Marjolin for gangrena senilis, more than twenty arteries required ligatures; and in the amputation of an arm which had been the seat of an aneurism, treated unsuccessfully by the ligature of the brachial artery, the operator, Professor Richerand, had scarcely divided the soft parts when streams of blood spouted from about twenty large arteries which it was found necessary to tie.

Hæmorrhage from the end of the bone, which very rarely occurs, is to be averted by pressure exercised for a short time with a small thick pledget of lint, or by plugging the canal containing the bleeding artery with a piece of softened wax.

Where the arteries of the limb have undergone the bony or osteo-cretaceous transformation, more than ordinary precautions may be necessary to secure the larger ones. In most cases of this sort it will be proper to use in preference to the large flat ligature recommended by the French, a round ligature twice or thrice the thickness of that usually employed; but if an artery has become so brittle as to give way to this, I would recommend tying it over some cylindrical body introduced into its canal, and not applied externally, as advised by Scarpa, and most of the French surgeons, for I believe it to be rather in the change of form than from any constriction exercised upon it that the vessel is apt to crack.

For such arteries the French surgeons recommend the use of a broad flat ligature, and sometimes the interposition between it and the arterial tunic of a small cylinder of linen or diachylon plaster whereon to tie the knot so as to close the artery by flattening rather than by circular constriction as advised by Scarpa. But I believe that the twisting which a flat ligature makes at the knot, and which it is apt to make elsewhere, will be found more cutting, and therefore more likely to divide the artery than any part of a round one. I am, therefore, inclined to believe that we cannot do better in these cases than use a round ligature twice or thrice the size of that usually employed. If, perchance, the tunics of an artery were found so completely ossified and brittle that they could in no way be brought together without breaking, probably the best plan would be to tie them over a small plug of linen introduced into the arterial canal.

It is stated by many surgical writers, that one or more of the veins may bleed so much as to require ligatures; and it was the practice of Dessault and of Mr. Hey after amputation of the thigh, to include the femoral vein and artery in the same ligature. We confess we have never seen such a practice necessary although we conceive there may be considerable venous hæmorrhage where no valve is interposed between the junction of branches with the bleeding vein and its orifice; and more especially after amputations performed near the trunk. It ought always to be dispensed with, if possible. The pressure of the dressing will generally prevent this reflux of blood, which may be always known to be venous from its colour, and which often flows from there being some slight temporary check to its return towards the heart.

In those amputations where the circulation cannot be sufficiently commanded, and where a great number of vessels must be divided, especially, if in such cases the patient happens to be one who cannot afford to lose much blood, it may be desirable to tie the principal artery of the limb before it is divided. This is often done with advantage in amputations at the hip and shoulder-joints, either as a preliminary measure, or before the division of the soft parts is completed. Some unforeseen circumstance may also render it necessary to stop the bleeding from a large artery after its division, prior to the completion of the amputation. In a case of amputation of the thigh, in which, from the inadequacy of the pressure exercised on the femoral artery, a terrible stream of blood spouted from this vessel the moment it was divided, Dupuytren instantly seized the artery with his left hand, while with the right he completed the operation, in his usual masterly style, as if nothing had happened.

When all the ligatures are applied, it is usual to cut off one string of each of them, near the knot, in order to diminish, as much as possible, the quantity of foreign matter to be left in the wound. It will be better for the assistant to do this for every ligature as soon as it is applied. They will thus be prevented from being entangled; the time often necessary to disentangle them will be spared, and there will be no risk of cutting away both parts of the same ligature. The remaining strings are to be collected, according to their proximity to one another, in one or more bundles, each of which is to be left out at that part of the margin of the stump, where it will least interfere with the union of the wound. Here the surgeon will feel the advantage of having employed small ligatures. In general, it will be found advantageous to leave out the principal bundles at the extremities of the wound, where they serve as conductors to the escape of any pus that may form. But stray ligatures, situated far from these extremities are sometimes better brought out at the nearest point of the edge of the stump, where they may be placed between the straps of plaster used to unite the wound. Care should be taken that each bundle and each separate ligature be drawn straight, so as to lie in a straight line from the knot to the exterior of the wound; because, if they are allowed to bag, the arched part tends to prevent the union of the wound; or, what is worse, becoming enclosed between its adhesions, is the cause why the ligatures do not come away, and cannot easily be withdrawn at the proper time. Mr. Crosse, to whom I am indebted for this remark, thinks the neglect of this precaution is the real cause of the difficulty sometimes found in removing the ligatures. The above precaution having been attended to, if the surgeon find the ligature rise, which it will often do, half an inch or an inch, so that less of it is buried in the stump, he knows that it is detached and remote from the vessel; and though resisted by granulations, he does not hesitate to use considerable force to remove it.

As it is desirable to leave as little foreign matter as possible in the wound, both strings might be removed with advantage near the knot, but that the latter would not easily come away. It would have to make its escape through parts healed over it, if one string were not left to keep the path open, and would thus cause greater irritation, and retard the complete cicatrization of the stump more than an entire ligature. This has been proved by direct experience. Mr. Fielding of Hull found that knots left buried in wounds produced pain and irritation for several weeks, and even for months; and the same effects induced Mr. Lawrence to discontinue the practice of having them thus enclosed, although he took great pains, and employed the fine dentists' silk, of which the knot weighed only from $\frac{1}{40}$ to $\frac{1}{20}$ of a grain. Similar results have followed in the trials made of ligatures composed of catgut and other animal substances, which it was supposed might possibly be absorbed.

It will be proper, then, to continue the practice of leaving one string, until we discover a substance for ligatures susceptible of being absorbed without producing too much irritation.

Some surgeons of our own time have attempted to dispense with ligatures altogether. Koch of Munich has been in the habit of relying, as a sufficient means to stop the bleeding, on the exact union of the wound, and some degree of pressure exercised on it by the dressing, and on the course of the principal artery by a bandage. Other modern practitioners[1] have contented themselves with the application of ice to the stump, after closing it firmly with straps or by suture.

These and similar measures may suffice to arrest the bleeding in many cases, but in many others they would be followed by dangerous hæmorrhage. To have recourse to, or confide in them, cannot be justified on any rational grounds. They are little better than those employed by the ancients, and any attempt to recommend them must be viewed as tending rather to the retrogression than to the advancement of surgery.

Far more deserving of consideration, and probably much less hazardous, is the plan of arresting hemorrhage by torsion of the arteries, which will be fully examined in the article Torsion. It appears to us to rest upon the same phenomena, as those which explain the absence of bleeding in cases where the arteries are irregularly broken, as when a limb is torn off. Torsion may deserve to be ranked, as far as convenience and perhaps safety is concerned, next to the ligature; but is, certainly, not sufficiently safe to supersede it. Velpeau, who appears to have given it a fair trial, was obliged to relinquish it, in consequence of the dangerous hæmorrhage which sometimes followed its employment.

The results of the treatment of bleeding arteries by *Fermeture*[1] and *Folding*[2], which have been fully noticed by the same author, prove that they are less efficient than torsion.

Although the other measures we possess of arresting hæmorrhage may rarely, if ever, be needed to stop the bleeding after amputation, they are not to be entirely lost sight of by the surgeon who undertakes this operation; because, it is possible he may sometimes find it useful to call them to his aid, and when had recourse to, in conjunction with ligatures, they tend, in the proportion to which they are employed, to render a less number of these necessary.

Dressing after amputation.—The ameliorations that have been introduced, in the mode of dressing the stump, are no less remarkable than those which have marked the successive periods in the history of amputation. The system of filling the cavity with lint or charpie, and of swathing the stump with compresses, and covering with the Maltese cross, the woollen bag, or cap, and various other means formerly in use, are now very properly abandoned.

From the time when Alanson first propounded the doctrine, and recommended the immediate union of wounds after amputation, the practice has been gradually advancing in favour, till now, when it may be said to constitute an exclusive method amongst British surgeons. Many of the continental surgeons however, the French more especially, have adhered to the older mode. We have thus two general modes of dressing; viz. *by first intention*, in which the lips of the wound are at once brought into close contact, and so maintained till the parts have grown firmly together; or *by second intention*, in which contact is prevented by the interposition of dressings of various kinds, and the union when it takes place is consecutive to suppuration. At no very distant period, the propriety of attempting union *by first intention*, in cases of amputation, was warmly debated, and while M. Roux charged British surgeons with an indiscriminate partiality for this plan, M. Larrey was of opinion that it ought to be proscribed altogether in these cases, in order to remove or lessen the chance of tetanus. The adoption of this mode, however, has continued to extend, and even now many of the French surgeons of eminence employ it in the great majority of cases; and those who still oppose it, have so far altered their opinions in regard to it, as to direct their attention chiefly to distinguish the cases in which the immediate or the consecutive mode respectively, is entitled to the preference.

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[1] I think Delpech, and some of the Italian practitioners.

[1] Closing or stopping the mouth of an artery, by inserting into it a cone of alum, cut in the shape of a cone.

[2] Doubling or folding the end of the vessel back on itself, and replacing it thus folded, in the soft parts, and closing the lips of the wound firmly upon it.

Some of the French surgeons still cling to the opinion, that when the secondary union is had recourse to, the prolonged suppuration prepares the constitution of the patient better for those changes which must take place in the organism after the removal of a large limb; that when a disease of long standing has transformed a limb into an abundant source of secretion, there may be danger in drying up the morbid discharge too suddenly, and that in such case, secondary union is by far the safest; that where the tissues in which the operation has been performed are in an unsound condition, it is highly improper to confront the surfaces with a view to immediate union. These cases, however, even if we admitted the reasoning to be correct, would only form exceptions. But the circumstances here assumed as objectionable to the immediate union, are not only not proved, but they are, by English surgeons, regarded as absolutely hypothetical.

The entire body of English and American, with a majority of the best German surgeons, agree in considering that the advantages in favour of union by first intention far outweigh the drawbacks which, in some rare cases, are attributed to it, while it is indisputable that the adoption of the secondary mode of union in all cases would be much less successful than the modern plan. How many there are in whom, by the prompt reunion of the divided parts, a degree of constitutional reaction, and protracted suppuration is prevented, which had they been allowed to take place, would, in all probability, have destroyed or greatly perilled life! Could it be affirmed that the secondary union, though a slower, was always the safer process, the case would doubtless be a strong one; but the very reverse of this is the fact: in secondary union the soft parts, which, at the time the operation was performed, were ample enough to form a good covering for the bone, are often so wasted by the long-continued suppuration, the pain and hectic fever produced by keeping the constitution under this drain, that when union is at last attempted, the covering for the bone is scanty, and the stump is conical. The inconveniences of the old mode are frequently very great, and, in too many instances, persons of good constitution, who would have recovered in a few weeks had a different plan been adopted, have fallen victims to an exhausting suppuration, or to the constitutional disturbance arising from a gleety and irritable stump.

Velpeau contrasts the two modes of dressing in a very striking manner, by comparing the results of Baron Percy's practice at the head of the military surgery of France, who adopted immediate union, with that of Pelletan, his contemporary, at the head of the civil hospitals of Paris, who was strongly prejudiced in favour of the mode of union by granulation. Out of ninety-two soldiers thus treated by Percy, on the field of battle, eighty-six were cured in twenty-six days. By the same mode, Lucas lost only five out of seventy-five. Out of six operated on by Pelletan, where secondary union was preferred, five died!

The opponents of immediate union cast upon it the reproach of preventing the free flow outwards of the blood, pus, &c., that may ooze from the surface of the divided parts. The morbid products thus pent up, they say, macerate the stump, and excite irritation, which extends up the limb, giving rise to fuses of pus, between the muscles and tendons, phlebitis, secondary abscesses in the internal organs &c. But this manner of putting the question is scarcely fair towards the advocates of immediate union, every one of whom acknowledges the necessity, when such accumulations occur, of giving them a free exit. In many cases, however, the quantity of pus collected is so small, that it finds a sufficient vent along the ligatures.

The remarkable success that has attended amputations in this country since the adoption of the treatment by immediate union, is a strong reason for the preference it universally obtains. But it cannot be denied, that it now and then fails, even under favourable circumstances. What, however, is the result? The patient is in no worse condition, than if secondary union had been preferred at first. Nothing has been lost in the attempt, but the chance which the surgeon thought it his duty to give him of primary union.

The question, however, remains, whether primary union should be attempted in all cases? We think not. Parts in a sloughy state, or which have been severely contused, will not unite in this way, and an attempt to effect it, would be worse than useless. Parts when not exactly in the healthy state, however, will very often unite in the most favourable manner, and in such cases immediate union ought to be attempted. Not long since, one of the writers of this article saw Mr. Wickham, of Winchester, perform a partial amputation of the foot, in a case in which not only the bones, but the soft parts, were considerably altered; the bones so much so, that there was no necessity of following the articulations, as the knife went through the bones themselves with the greatest ease, and yet the flap and bones united rapidly and kindly, with very little suppuration.

To dress the stump properly requires great nicety and care, and it will not be too much to say, that upon these the success of immediate union must often depend. The section of the soft parts ought to be as even as possible, and made in such a manner as to allow of their covering the bone so amply, that no effort shall be required to make them do so. The bone itself should not start beyond the surface of the deep-seated muscles, but be the centre and deepest point of the hollow cone, which they ought to form.

Taking for granted that this state of the parts exists after a due performance of the operation, the surgeon now proceeds to tie the vessels, one by one. The large vessels are sought for in their situations, and being secured, the tourniquet, if one has been employed, may be relaxed, in order the better to enable him to detect the smaller vessels, by seeing the blood spirting from their mouths. These he may tie or twist. When he has rendered himself master of the bleeding, he carefully and gently applies a soft sponge squeezed out of warm water, with which he cleanses the surface of the wound and surrounding parts from blood, foreign bodies, &c., wiping them with a piece of soft dry linen. This done, he disposes the ligatures in such a manner, as to keep them free from entanglement, cutting one of the ends off at the knot, and carrying each of them out at the point of the wound to which it is nearest. If the threads are numerous, they should not be collected together, as such an arrangement might prevent adhesion between the deep surfaces of the flaps; but if only a few vessels have been tied, the ends of the ligatures may be all brought out together at the inferior angle of the wound.

The next step is to bring the divided surfaces into close contact with each other. In the double flap or oval amputations, the line of union corresponds, of course, with that of the incisions themselves; but in the circular method, they may be brought together, either in a vertical, or horizontal line; that in which the bone will be best covered, and the stump best shaped, ought to be preferred.

The object in confronting the divided surfaces is to obtain and maintain contact between them at all points. It will not be enough to have the lips alone in coaptation—contact must also exist in the depth of the wound. The loose soft parts, therefore, are drawn gently down over the extremity of the bone, and the wound is evenly closed from the bottom, the edges of the skin forming a straight line, corresponding to the small diameter of the limb. An assistant maintains the apposition, by pressing with the palms of both hands, while the surgeon, with both hands, takes a warm adhesive strap, and after applying one end of it to one side till it sticks firmly, carries it over the closed lips of the wound, and causes it to adhere in the same manner on the opposite side of the stump. In general, the first strap is applied over the centre of the wound; more especially when the line of union is extensive. Other straps are applied in succession, until the coaptation of the entire line is completed. When the straps are cut of equal width, small spaces should be left between them, more especially at the lower part, to admit of the escape of pus, or other matter from the wound. Some surgeons provide for this by making the adhesive straps somewhat narrower at the point that crosses the line of union than any other.

Moderate compression will be required to effect complete coaptation at the bottom of the wound, and for this purpose, two linen compresses should be applied at each side of the base of the stump, which may be secured in the roller. The advantage of this will be, that as the roller prevents the retraction of the muscles, and gives the tissues that degree of support that protects them from the fusing of pus, so will the compresses prevent the formation of a large cavity at the bottom of the wound, which, even though the lips remained well closed, would result from the separation of the flaps at a greater depth from the surface, and in which an extensive suppuration might take place, and destroy the chance of speedy union and cure.

The adhesive straps may be lightly covered with a piece of lint or fenestrated linen, spread over with simple ointment; one or two lengths of soft linen, or lint folded as compresses, will complete the dressing.

The best authorities in this country recommend the application of the roller, not only to give support to the dressings, but to prevent retraction of the muscles, and the conicity of the stump. The mode in which it is recommended to be applied by Alanson, Louis, Richerand, and Sir A. Cooper, is to make the first turns on the trunk, thence carrying it down the limb in circular turns.

In the circular amputations, few surgeons in this country at the present day ever employ sutures to keep the edges together; with ordinary care, the roller and adhesive plaster being found sufficient for that purpose.

Care after amputations.—As soon as the stump is dressed, the patient should be carried to bed, and if he feel faint, a little wine should be given. He should be made to take an easy position in bed, and the stump should be protected by means of an iron or wooden semi-circle, which will at the same time suspend the bed clothes. The stump itself should rest on a pillow or cushion in a horizontal position. It is recommended by some surgeons to elevate the stump, in order to procure the complete relaxation of the muscles, and diminish the tendency of the blood towards the wound. This elevation, however, may be carried too far, and most probably the horizontal position, recommended by Hippocrates, in which the limb approaches the state of semiflexion, is the best. In the larger amputations, the pain and loss of blood are sometimes so considerable, that the powers of the patient soon after the operation seem to be greatly depressed. It will be, therefore, proper to administer some anti-spasmodic or stimulant, and keep every thing about him in a state of perfect stillness, that the depression under which he labours may dispose him to sleep. It will be often found useful to fix, by straps or strong pins, the stump to the cushion on which it is supported, to obviate the agitation, twitching, and subsultus, which might else either interrupt or even prevent sleep altogether. Sometimes the spasms of the stump occasion great distress, preventing sleep for a long time, and exposing the patient to the misfortune of having a conical stump. When this is the case, recourse must be had to the free use of camphor and opium, to the compression of the limb with a bandage, and to the proper fixation and semiflexed position mentioned above. In the old methods of amputating, spasm was a very formidable occurrence, often defying all control, and terminating in tetanus and death.

After amputations as they are now performed, these spasms decline in general from the first day, when they are at the highest, to the fourth or fifth, when they generally disappear. It has been observed that those who, by an effort of heroic constraint, repress every manifestation of suffering during the operation, are peculiarly predisposed to spasm. There is nothing surprising in this: the effort must greatly exhaust the nervous energy of the patient, and be thus conducive to nervous accidents. He should be directed not to impose too stern silence upon his pains; his cries of distress are not only natural, but assuaging.

The immediate union of the wound will be best favoured by keeping the stump cool. Cold, or iced water is employed for this purpose; and some surgeons steep their compresses in water containing a certain portion of spirit. When the stump is kept wet, a large piece of oil-cloth should be made use of to protect the bed, Cold may be applied still more commodiously by enveloping the stump in one or two bladders, partially filled with cold or iced water, to be changed for others when the temperature increases. One of the best topical refrigerants with which we are acquainted, is produced to hand by putting powdered camphor between two pieces of cambric, and applying them wet.

Accidents that may arise during the operation.—The most formidable of these is hæmorrhage. Notwithstanding the resources we possess in the tourniquet, compression by the hand of an intelligent assistant, the pad, key, &c., cases occur now and then, in which, from particular causes, a considerable quantity of blood may be lost. This may arise from a variety of causes: the means for preventing the hæmorrhage may have been badly applied, or the individual case requiring the operation may be of such a nature, that they cannot be properly applied; or again, the tissues divided may be so abundantly supplied with blood-vessels preternaturally dilated, that the compression is ineffectual.

When the hæmorrhage is so abundant as to endanger life, there is no time to be lost; the operation must be terminated as speedily as possible. Three or four of the principal bleeding vessels may be commanded by the assistants, while the surgeon applies rapidly and successively his ligatures; or, if several torsion forceps be at hand, the mouths of the bleeding vessels may be locked in their beaks, and thus held until the surgeon can tie them at his ease. This instrument will be found invaluable in these cases; more especially in amputating on the field of battle, where the assistants are few in number. When the amputation is performed with flaps, an assistant can make compression on the principal vessels, by grasping in both hands the whole mass of the flap itself, and ligatures may be applied at once, without waiting till the bone is sawed off.

The hæmorrhage may arise from the veins; in which case, it may be caused by the compression made upon the limb. In a case in which one of the writers of this article performed an amputation of the thigh for a diseased knee-joint, with extensive ulceration, and abundant suppuration, no sooner was the tourniquet applied, than the venous blood, the return of which it prevented, burst out, in black and copious streams, from the ulcerated cavity at the joint.

It has been recommended to tie the bleeding veins in such cases—a practice which ought, if possible, to be avoided. If the bleeding depends upon undue pressure, it will cease upon its removal. The return of the venous blood may also be checked by the patient's straining and holding in his breath, in which case, he should be directed to breathe freely, and refrain from effort of every kind.

It sometimes happens, when all the bleeding vessels have been tied, and the dressing is completed, that an oozing of blood takes place, or even some of the small vessels, that on exposure, had retracted, and immediately ceased to bleed, furnish blood afresh, as soon as the patient has become warm in bed. This effect of re-action requires to be carefully watched. Dupuytren, in order to obviate this occurrence, used to defer the dressings for several hours, in expectation, that on recovering from the shock of the operation, these small vessels might be discovered and secured. It will be best prevented by the application of cold to the stump. The bleeding from the capillaries may depend on the tightness with which the roller is applied; and, should such be the case, it should be slackened. If the quantity effused be not sufficient to produce a feeling of distress from tension, it will be best not to disturb the dressings, further than to slacken the roller, remove the compresses, and expose the stump to the action of the cold; for this purpose the compresses may be kept wet, or ice may be applied in bladders.

The hæmorrhage may arise also immediately after the operation, from the ligature slipping off the vessel. In this case, the tourniquet, if it be left on the limb, should be immediately tightened, or the vessel may be controlled with the fingers; the dressings should then be removed, and the vessel secured effectually by placing the ligature in a proper manner; if the coats of the vessel have given way, it should be drawn out, and tied with a round or thick thread, which will make sufficient pressure, without cutting the vessel across.

Removal of the first dressings.—If there be nothing in the stump to call for particular attention on the part of the surgeon, the first dressings should be allowed to remain undisturbed till the fifth or sixth day. Any considerable accumulation, however, of blood in the cavity of the stump, by acquiring irritating qualities, or tightening the adhesive straps to a painful degree, will require a much earlier disturbance of the dressings. Their renewal is in general much dreaded by the patient; but, if the surgeon proceed methodically, and with due care, he will not give any pain worth speaking of, nor will he disturb the adhesions already formed between the edges of the wound. The blood and serum which has glued all the dressings, being now dry and hard, should be softened with soft sponge dipped in warm water, or the water may be made to fall in a gentle stream upon them, until they become thoroughly softened, when they will separate easily. The roller and compresses are removed first, and then the adhesive straps in succession. If the stump be large, each strap should be removed, and replaced by another before the next strap is disturbed; by this means, only one point of the wound is deprived of support at a time. Before the application of the fresh strap, the exposed part of the stump is gently spunged and wiped dry.

In detaching the ends of the straps, they should be raised, first, on one side, till the skin is uncovered nearly down to the edge of the wound, and then on the other side, approaching the wound in the same manner; both ends are then laid hold of, and gently raised perpendicularly from the surface of the stump. It is not uncommon for some of the small ligatures, to come away with gentle traction on the fifth or sixth day; the larger ones may be removed on the tenth or twelfth. If they should remain after the fifteenth day, gentle tractions should be made on them at each time of renewing the dressings.

Secondary accidents after amputation.—At the period when the ligatures come away, and even long after, hæmorrhage may take place. The healing of wounds from amputation by immediate union has tended more than any thing else to diminish the frequency of this accident. In this mode, the divided vessels are not exposed, nor irritated by any thing, beyond the ligature itself: they are covered by, and in contact with parts living like themselves, and with which they soon become intimately united. One of the great causes of the inflammation of the stump and its vessels is thus guarded against, and the ulceration, through means of which the ligature is freed from the vessel on which it had been applied, is in almost the universality of cases limited to that point alone.

It does, however, happen, in some rare cases, that inflammation and suppuration taking place in the coats of the arteries of the stump, the coagulum, instead of becoming organized and obturating the vessel, is expelled, and hæmorrhage occurs, at a period when the stump is all but completely healed, the blood flowing from the fistulous tracks of the ligatures.

Secondary hæmorrhage may also occur, when the stump having been attacked with inflammation, the soft parts become sloughy. Under these circumstances, the obliteration of the vessels does not take place, and the blood may burst out from one or more of these vessels at the same time, or in succession. This is observed to occur in cases where amputation has been performed for mortification of a limb arising from internal causes, or when the vessels had been in a diseased condition prior to the operation.

The period at which consecutive hæmorrhage may occur, will vary according to circumstances, from the end of the first to that of the fourth week, and is, generally speaking, a very serious and often unmanageable accident.

When the artery has been re-opened by the progress of sloughing or ulceration, it will, perhaps, be hopeless to attempt securing it again in the same place where these morbid processes are in activity. Sanson, however, was successful in a case, where he secured the mouth of the bleeding vessel, including in his ligature a portion of the soft parts which he dissected for some way upwards.

It has been recommended to make compression on the course of the arterial trunk, by means of a pad. J. L. Petit was successful with an instrument called a *garrot*, which he invented for a case of this kind, and by which a pad might be pressed on the course of the artery or a piece of sponge or agaric might be maintained against the bleeding mouths of the vessels themselves. This mode of using compression, particularly in thigh stumps, has been favourably spoken of by White and Hey, but they prefer compression by the hands of assistants who would take the duty in turns; the pressure to be kept up until granulations arise, and all likelihood of a return of the hæmorrhage ceases. The fatigue to which the assistants would be exposed in this service might be easily spared, as the materials with which it is made, either agaric or sponge, might be readily applied, with proper and regular force, by means of a compress and roller.

Should all these means, however, be unsuccessful, the surgeon has still in reserve a precious resource in the ligature of the artery higher up in the limb. Having determined on the point at which the vessel is to be tied, he cuts down to it, and places the ligature upon it, as in the operation for aneurism. In this object too, he is not quite certain of not being disappointed; for the vessel may be unsound even here, or, what is more likely, the collateral vessels may still continue to carry the blood to the perforated vessel, from which the hæmorrhage took place. M. Roux, who recommends the practice, had a patient in the Charité on whom he amputated the leg. Secondary hæmorrhage, from ulceration of the popliteal artery, compelled him to tie the femoral artery, but the hæmorrhage was only momentarily interrupted: the blood conveyed by the collaterals into the lower part of the artery gushed out as fiercely as before, and the unfortunate patient, was obliged to submit to have his thigh amputated to save his life.

There is another form of consecutive hæmorrhage, mentioned by Gouraud, resulting from the irritation of a necrosed bone. Compression will have no effect in arresting it: the dead bone must be removed, and the dead soft parts cut away, before the hæmorrhage, which is sometimes considerable, can be commanded.

But whatever be the plan resorted to for checking the hæmorrhage, if the soft parts of the stump are in a sloughy state, or otherwise ill-conditioned, their vitality must be modified before they will put on healthy action. For this purpose, Hey recommends the application of lint soaked in equal quantities of lemon juice and rectified spirit of wine.

Inflammation of the Stump.—When the surfaces have been properly put in contact, the dressing performed without making undue compression, and the stump is kept cool, it will seldom inflame; but on the contrary, the reaction will be slight, and adhesion will be found to have taken place extensively, often indeed at all points, except those occupied by the ligatures. It sometimes, however, happens, possibly in most cases from want of proper attention at the time of applying the dressings, that blood effused from a neglected vessel, or pus thrown out from surfaces irritated and indisposed to adhesion, stagnates at the bottom of the wound, thus forming a focus, from which inflammation of an unfavourable character extends over the whole stump. At first there is an increase of the local pain, the parts swell, and the feeling of constriction becomes more and more distressing; the pulsation of the vessels becomes sensible, extending towards the trunk; the edges of the wound are gaping, and of a livid red. The pulse is full and frequent, the countenance flushed, the eyes brilliant, the tongue red. If the dressings be not speedily removed, the traumatic fever reaches its height, and delirium supervenes.

No time should be lost in removing the adhesive straps and freeing the stump from all constriction. It may be fomented, or at once enveloped in an emollient poultice. If the inflammation is allowed to proceed unchecked the lymphatic vessels redden, and the ganglions swell, the muscles retract, the wound bursts open, giving issue to a small quantity of dirty pus, and its surface exhibits a greyish hue; this inflammation is of the erysipelatous kind, and prone to terminate in gangrene. Vigorous and vigilant treatment, local as well as constitutional, will now be necessary, not only to avert the danger with which life is threatened, but to prevent such extensive sloughing, as would deprive the bone of a proper covering, and expose the patient to the miseries of a conical stump.

Sometimes the mere exposure of the parts, and the cessation of all constriction upon them, will give a sufficient check to the progress of the untoward symptoms. Sometimes, however, this will not be enough. The local symptoms still persist, resembling closely those of hospital gangrene; abscesses are formed here and there, and extend upwards; and low fever, with stupor, or excessive prostration supervenes. In this state, various remedies, both local and general, may be had recourse to; some surgeons combat the inflammation by covering the surface of the stump, with leeches, emollient poultices, or emollient and narcotic fomentations; some prefer free and deep incisions. Larrey, Dupuytren, and others speak highly of the actual cautery. The general indications are those of typhoid fever.

Conical stump.—Louis was the first who discovered the real cause of this evil. The retraction of muscles depends on the number and length of their fibres, and is proportionate to these two conditions. If two muscles be cut across, the fibres of one being three times longer than those of the other, the retraction in two portions of the longer fibres will be three times as great, as in two portions of the shorter; the third or internal portion of each retracts least, the fibres are shorter, being internal, and united to the neighbouring parts by more dense cellular tissue. The looseness or density of the cellular tissue, which connects them with the surrounding parts, contributes also to the extent of the retraction. Since the mode of dividing the muscles recommended by Cheselden and J. L. Petit was adopted, the conicity of the stump, which was formerly a frequent consequence of amputation, is now but very rarely observed; it however occurs sometimes from miscalculation as to the size of the flaps, but much oftener from retraction of the muscles, in consequence of sloughing, or long continued suppuration.

The greatest number of conical stumps occur after field amputations, where, from the hurry attendant on their performance, imperfect dressings, and the want of sufficient assistance, the parts inflame, suppurate, and retract.

After retraction, the muscles are seen drawn high up in their sheaths; the external layers are the most retracted, the internal still adhering to the bone, which, contrary to the rules of the art, forms the centre of a projecting instead of a hollow cone. When conicity is the result of miscalculation on the part of the surgeon, at the time of the operation, Mr. Guthrie recommends the removal, by the saw, of such an additional portion of the bone as will allow the remainder to be well covered; and he thinks it is better to do so at once, before attempting to dress the stump, than to expose the patient to the necessity of undergoing another operation at a future time. The surgeon should bear in mind that the degree to which the muscles retract, varies in different subjects, that his calculation may be erroneous from œdema, or fulness of the limb, and that he must endeavour to be on the safe side by saving sufficient soft parts to form a good covering.

Abscesses and sinuses of the stump and limb.—As a consequence of inflammation, matter in more or less quantity may be formed in the stump, and being pent up, it burrows, and extends into the neighbouring parts. Its progress upwards is facilitated by tracks of cellular tissue lying between the muscles and by the open ends of tendinous sheaths. Some amputations, such for instance as those of the wrist and tarsus, are peculiarly liable to this accident, owing to the numerous synovial sheaths which surround the stump. The most serious consequences may arise, if this diffusion of the matter be not prevented in time. Counter-openings must be made, wherever they are required, to give a clear and speedy exit to the pus. The mode of forming those counter-openings has been already described in the Article Abscess. The reaccumulation of the matter must be guarded against by the proper application of graduated compresses along the track of the sinus, and expulsive pressure should be gently made at each time of dressing, in order to prevent any lodgment. With due care, and a proper outlet for the matter, the frightful mischief which would arise from its extension up the limb, will be prevented.

Necrosis.—When amputation is performed according to the rules laid down in the preceding part of this article, all proper precautions having been taken to preserve the life of the bone, this accident will rarely occur. With the older surgeons, who held to the pernicious practice of scraping the bone, and detaching from it, the soft parts, and the periosteum, the death of some portion of the bone, was not only an ordinary, but an inevitable event. Now, as well as then, it is most commonly the consequence of want of protection, or sufficient covering from the soft parts.

But in some rare instances, the exfoliation may arise from the injury done to the bone by the operation, or in consequence of its being in a diseased state. The bone may also become denuded, and exfoliate from violent inflammation and long continued suppuration, or sloughing of the stump.

M. Renaud mentions another cause of necrosis, viz., the inflammation of the medullary membrane. According to his observations, the periosteum is detached, and the bone dies in the extent occupied by this form of inflammation; abscesses are also formed in the vicinity of the bone. The stump itself, though not inflamed, has a doughy feel; and in some instances, a yellowish hue; and the suppuration is abundant.

When only a small portion of the bone is affected, it will be thrown off, in some cases, after a considerable lapse of time, in the form of a ring, and the stump heals immediately. When the sequestrum extends to the height of several inches, it is a debated point whether it should not be resected out at once, or left to be detached by the slow and natural process of separation. Some surgeons represent this as a very trifling, others as a most serious operation; and both opinions are correct, according to the nature of the case. When the portion to be removed is small, and easily accessible to the saw, the operation will be but a very trifling one; but when, on the contrary, the skin and muscles have shrunk away from the bone to a considerable extent, its removal may be likened to a second amputation. Bertrandi recommends a perpendicular fork of wood, whereon to rest the necrosed bone, while the saw is applied to it close to the flesh. When exfoliation takes place, long after amputation, the sequestrum may be sometimes detached by the forceps; and as a preparation for this event, it will be proper at the time of dressing to shake and work on its end; if it vacillates in any degree, the attempt may be made with somewhat greater force.

Velpeau affirms that necrosed portions of bone are sometimes shut in by the surrounding soft parts, and that the cure takes place without their being detached at all. He mentions a case where the stump suppurated, in which the ends of the tibia and fibula were completely necrosed. After remaining exposed for a long time, they became gradually lost in the soft parts, and cicatrization took place.

When there is considerable denudation, and it becomes necessary to remove the dead bone, care should be taken to detach the muscles to a sufficient extent to secure a good covering for the remaining portion, and in so doing, to avoid as much as possible the great vessels and nerves.

Cystitis.—When amputations have been performed for the removal of a considerable extent of parts, the abdominal limb for instance, a degree of irritability in the bladder, in some rare instances, proceeding to inflammation may be observed. This phenomenon in all probability is nothing more than a modification of the reactionary effects of the operation. Some surgeons, however, explain it in a different way, from observing that its occurrence is coincident with the application of a blister. At all events, it is certain, that we are sometimes compelled to use a catheter after amputation in persons who had never previously felt the slightest symptom of derangement in the functions of the urinary organs, and taking it therefore for granted that such a predisposition exists, we should be very circumspect in the employment of such remedies under the circumstances.

Phlebitis.—The phenomena accompanying this species of inflammation have been long known, but the rationale of their development has been till very recently but imperfectly understood, and even now the ingenious theory on which it rests is not universally acknowledged.

The inflammation of the veins, either alone or in connexion with the surrounding parts, is manifested by symptoms, which deserve particular attention, for it is only by taking such steps at the very outset, as are calculated to arrest their progress, that we can hope to save the patient's life. When pus is formed in the veins, and the internal organs are irritated by the circulation of this fluid with the blood, the patient's doom may be said to be sealed, as the case is almost beyond the resources of art.

The inflammation of the veins is marked by a train of local and general symptoms: the stump feels tense, swollen, and excessively painful; the removal of the dressing, however carefully performed, is torture to the patient; the fever runs high, and is continued beyond the ordinary period; the tongue becomes dry and dark, and the strength gradually fails. The course of these phenomena is rapid. Matter is soon formed, which, mixing and circulating with the blood, gives rise to another and more formidable train of symptoms: the patient has sharp rigors, and is very much agitated; to these succeed a burning hot stage, and an abundant and clammy perspiration; the countenance is sunk and earthy, the pulse frequent, small, and trembling; the skin is clammy, or very hot and dry; in a word, the traumatic has been converted into a typhoid fever, and the prostration of strength is extreme. The adhesions that had taken place in the stump are dissolved; the character of the suppuration is altered; the surface of the wound is greyish and gleety; burning pains are felt up the limb; the muscles retire within their sheaths, and the bone protrudes.

If we now turn our attention to the pathological alterations that have taken place in remote organs, we shall see how extensive and deadly the lesions are which follow the inflammation of the veins. Collections of pus are found in the lungs and liver, in the serous cavities, and in the articulations; they are also found, though less frequently, in isolated focuses in the spleen, kidneys, or diffused in the cellular tissue, and even in the substance of the muscles. In the parenchymatous organs these focuses are observed, sometimes in the same organ, progressing through the various gradations between a simple stain or ecchymosis and a true purulent collection. Analogous differences are observed in the conditions of the altered product itself; in some instances, as in the lungs, pure pus may be pressed out of the small branches of veins; in others, as in the liver, the pus seems to be blended with, or infiltrated into isolated points of the organ which are softened, and of the consistence of cheese; the circumference of these points is highly injected.

Some years ago, it was supposed by Velpeau, Ribes, and others, that these formations were produced by the deposition of pus which had been absorbed at the suppurating surface. This was the opinion of Quesnay, who imagined that the pus was not formed in the vessels, but that, being carried into them by the absorbents, it was subsequently deposited by those vessels throughout the different organs of the economy.

M. Dance's researches on this interesting subject, have led to a different and perhaps to the correct explanation of the mode in which these lobular alterations are produced. M. Dance states that the pus formed by the local inflammation of the veins is intimately mixed with the blood, which being thus rendered more fluid, is extravasated in the cellular interstices of the organs; it here acts as a foreign body, determining an inflammation of a peculiar character, passing rapidly through its several stages, and terminating necessarily in suppuration. (See Purulent Depôts.)

When the first symptoms of this very formidable accident are observed, it will be best to soothe the stump with emollient and narcotic fomentations or poultices. General bleeding will be indicated according to the state of the patient. In the second stage, the strength of the patient must be sustained, and for this purpose, wine and bark have been favourably spoken of. Blandin was successful in a case which he regarded as hopeless, by powerfully exciting the secretions, and by the use of blisters, both to the limbs and trunk.

The other accidents common to operations in general, such as, excessive pains during and after the operation, lipothymiæ, and even death itself, will be noticed under the proper head, Operation.

Progress of cure in the stump.—When the process of cicatrization goes on without interruption, it differs in no respect from what is observed to occur in other wounds. The period immediately after the amputation, and up to the third or fourth day, is marked by the twitchings and spasms of the limb, and a degree of inflammation, in general slight.

which is necessary for the accomplishment of the adhesive process. When the stump is kept cool, the traumatic fever is slight, and the sympathetic disorder of the remote organs is scarcely perceptible.

As soon as the wound is completely cicatrized, the edges are puckered all round; the muscles converted into a whitish fibrous tissue, the blood-vessels transformed into ligamentous cords, and the nerves are all blended together in the cicatrix. The nerves are enlarged at their extremities, sometimes to a considerable size. These productions are formed by the indurated neurilemma, and are often the seat of pains, which are felt more especially at the changes of the weather.

The sawed extremity of the bone undergoes also considerable change: the first effect of the reaction is a tumefaction of its tissues. A gelatiniform secretion takes place both from the periosteum and the medullary membrane; it is shed over the whole osseous and medullary surface, and is finally ossified. When this process is completed, the tumefaction subsides, and even the bone becomes as it were atrophied, so that its end grows smaller, and more pointed, adhering to the cicatrix in the same manner as the surrounding soft parts.

Modification of the constitution after the ablation of a limb.—When the general health is perfectly re-established, it often happens that the person who has a limb amputated, becomes suddenly corpulent. This is easily explained; the quantity of food consumed being the same, and the quantity of parts to be nourished being diminished, the nutrition is relatively augmented. The effect of this plethora is often manifested in palpitations of the heart, headach, somnolency, &c. The practitioner should check any tendency to congestion by appropriate means, by bleeding, purging, &c., until such time as the equilibrium becomes finally established, and the economy is habituated to the new state of things.

PARTICULAR AMPUTATIONS.—SUPERIOR EXTREMITY.

So great is the value of the least portion of the thoracic limbs, that the rule, in regard to the amputations to be performed on them, is to preserve all we can; or, in other words, to operate at the most remote point from the trunk, at which the lesion requiring amputation will allow. With the caution thrown out, as regards articulations, particularly those of large extent, it may be stated, that amputation, on the various parts of the thoracic member, may be performed either in the continuity or in the contiguity: the points for operation being at various parts of the fingers, at their joints with the ends of the metacarpal bones, or in the continuity of these bones, at the carpo-metacarpal and wrist-joints; at various parts of the fore-arm and arm, at the elbow and shoulder-joints, and amputation has even been performed on the clavicle and scapula.

AMPUTATION OF THE FINGERS.

The amputation of the fingers is scarcely mentioned by the ancients. When first resorted to, it appears to have been generally performed in the continuity, and as late as the time of Fabricius Hildanus, it was the custom to chop off parts of the fingers, with a kind of hatchet, or with a chisel and mallet. At the present day, it is most commonly performed at the joints. It is, however, unquestionably, in some cases, more advantageous to saw through the bone; when the injury is limited to the joint, it will be better to amputate just beyond it, than to pass a whole phalanx length of sound parts to reach the next joint. This opinion is supported by Ledran, Velpeau, Guthrie, and many other English surgeons.

In these, as in all other amputations, the operator should bring to his mind the anatomical structure of the parts on which he has to act. The fingers are formed, each of three phalanges, somewhat convex posteriorly, and slightly concave on their palmar surface. On their dorsal surface is expanded and fixed the tendon of the extensor muscle, a small quantity of cellular tissue, and a fine and sensitive integument covered anteriorly by the nail. Fixed to their palmar surfaces, lies a fibrous sheath, lined by a synovial membrane, which is reflected from the two flexor tendons it contains. One of these tendons is inserted into the tubercle of the third phalanx, whilst, the other held close in its place by a fibrous band, is implanted by two strips, one on each side into the second phalanx at about its middle. There is, besides, a good deal of cellular tissue modified to support the skin which is here converted into a membrane of special sensation. There are also two arteries, one at each side, with their accompanying veins, and two large nerves similarly disposed, which exhaust themselves chiefly on the skin, at the end of the last phalanges. The digital articulations, strictly so called, are ginglymous; the metacarpo-digital or knuckle-joints are enarthrodial.

The bare enumeration of the parts entering into the structure of organs devised for such admirable and infinitely varied motions, and connected by an additional bond of sympathy with the rest of the economy, as the organs of touch, will be sufficient to warn the surgeon that the ablation of them may be sometimes attended with serious consequences. When inflammation arises, it is easily propagated along the sheaths to remote and important parts. It will also be obvious that the soft parts on the palmar are better adapted than those of the dorsal surface, to form a flap, and that compression by the dressings instead of ligatures, may, if the surgeon pleases, be employed to stop the bleeding.

The bones of the fingers are large in relation to the quantity of soft parts from which the covering after amputation is to be derived, and when sawn through, present a large extent of sharp edge to the skin, which is almost their only covering. Whilst, on the other hand, their articular ends present a round surface for this covering. Amputation at the joints of the phalanges is, therefore, a better operation than that performed in the continuity of these bones; but its superiority is not so decided as to compensate for the loss of the least portion of the finger that may be useful; consequently, it should be performed in preference when it inflicts less curtailment than the other, unless the portion be too short to be of any use (the limit in point of utility may be stated at one-half for the last, and one-third for the first and second phalanges), and it should, of course, be preferred when the curtailment by either operation would be about the same.

Some have advised, rather to remove the whole finger than to leave the first, or any part of the first phalanx; because, say they, this phalanx having no flexor tendon inserted into, or bound down to it, would yield to the extensor, and stand out so as to be inconvenient. But this opinion appears to be erroneous, inasmuch as the end of the tendon becomes blended in the cicatrix or fixed to the bone, so as to move the latter. There is, therefore, no reason to remove a portion of the finger, because the tendon is not attached to it, still less to adopt the suggestion which Lisfranc makes to incise or lay bare the tendon, and which might cause troublesome inflammation. It is, besides, an oversight to say, that the tendon has no attachment to the bone, it being in reality so attached by a white fibrous bridle to this first phalanx.

Although a surgeon may amputate portions of a finger with tolerable facility, unaided, it will be better to have the finger presented to him extended by an assistant, who will support the hand, and keep the other fingers bent in the palm.

There is some difference as to the celerity with which amputation of the fingers may be performed by these two methods. When the phalanx is removed by disarticulation, it is done almost in the twinkling of an eye; but when the bone is to be sawed, it is more tedious. But whether in the contiguity, or in the continuity, the operation may be performed, perhaps, with equal advantage, either by the circular or the flap method.

Circular method.—The skin, with its cellular tissue, is to be divided round the finger with a narrow scalpel, or bistouri, and then drawn back or dissected off, to the extent of about half the small diameter of the phalanx; a second incision is to divide the fibrous tissues, and make a track for the saw, at the place to which the edge of the skin has been retracted, and there must the bone be sawn through. The surgeon will find it advantageous to use what the joiners call a dove-tail saw, and while sawing the bone to place the finger on a firm cushion. When the surgeon operates in the contiguity, he is to open and cut through the joint, after the divided skin has been drawn back to it, in the manner described in the flap amputation. The circular method is much employed in England, and is, for the formation of a good digital stump, as good as any other.

Flap method.—The flap method for the removal of the fingers includes several different modes. It may be performed with a single palmar or a single dorsal flap, according to Lisfranc's plan; or by a right and left flap, cut from the sides of the finger, according to Maingault's plan, which is justly censured by Blandin; or by a dorsal and palmar flap, each of equal length; or, in fine, by a dorsal and palmar flap, the latter being made longer than the former.

With a single palmar flap.—In Lisfranc's mode of performing this operation, the hand in pronation, the phalanx to be removed is bent, the edge of the knife is made to enter at the side of the finger about a line or two in front of the transverse fold of skin that marks the situation of the joints. The edge of the straight bistouri being inclined, as if he aimed at the centre of the condyle behind it, the joint is opened at the first stroke; the handle of the bistouri being now brought down to the horizontal, the edge comes in contact with the skin at the back of the joint, which, with the extensor tendon, it divides, laying open the joint itself. The lateral ligaments being stretched are easily divided by inclining the edge, first to one side, and then to the other. The operation is terminated by forming a semicircular flap of sufficient length from the soft parts of the disarticulated bone, by directing the edge of the bistouri nearly parallel to the bone, from behind forwards.

Fig. 9.

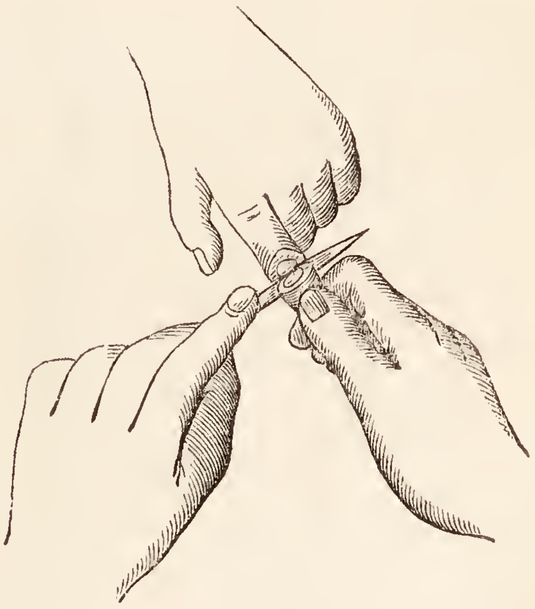

Fig. 9, *Lisfranc's method of amputating a finger: the flap is taken from the palmar surface of the phalanx to be removed. The surgeon is operating on the left hand, and holds the knife in his left hand.*

With practice upon the dead subject, these several steps may be executed with such rapidity as to form but one continuous sweep. In forming the flap, we should be very careful to have it of the proper size. Delpech used to ascertain the proper length of the flap, by measuring it against the articular head which it was destined to cover, before he completely cut it. This operation may also be performed by passing the bistouri flat, from side to side, through the soft parts in front of the joint, on the palmar surface; then lifting up the flap, laying open the joint, and completing the division by carrying the knife out at the dorsal side.

With a single dorsal flap.—In forming the flap from the dorsal integument, the first process above described is reversed. The phalanx to be removed is presented in supination; the skin being retracted by an assistant, is divided transversely about a line or two in front of the palmar fold of the joint; the sheath, tendons, and articular ligaments are next divided, and a semicircular flap is formed from the skin of the phalanx which is to be removed.

In the former plan, the cicatrix being on the back of the finger is more exposed; but to compensate for this disadvantage, the flap cut from the palmar surface is thicker and protects better. The dorsal flap, in general, is only had recourse to where the palmar soft parts have been too much damaged to make a good covering for the end of the bone. In forming the palmar flap, the tendon, owing to the obliquity of its section is liable to protrude beyond the skin. In such a case, the protruding portion must be removed; and, for this purpose, it will be best to employ strong clean cutting scissors.

With a palmar and dorsal flap.—The phalanx to be removed is presented bent and in pronation. An assistant, holding the hand, keeps the other fingers strongly bent out of the way of the knife. The surgeon takes hold of the end of the finger, and determining the situation of the joint, which will be about a line below the sort of knee formed by its bend, he cuts with a narrow bistouri, a semicircular flap, between three and four lines in length, with its convexity towards the nail, proceeding from one side of the joint to the other; this flap, which is almost entirely skin, being raised as far as the joint, and upheld by an assistant, the joint is laid open, and its ligaments divided in the manner already described. As soon as the articulation is quite gone through, another semicircular flap of the same or greater length, is formed from the phalanx to be removed, by carrying the edge of the bistouri obliquely from the under surface of the bone to the skin.

Fig. 10.

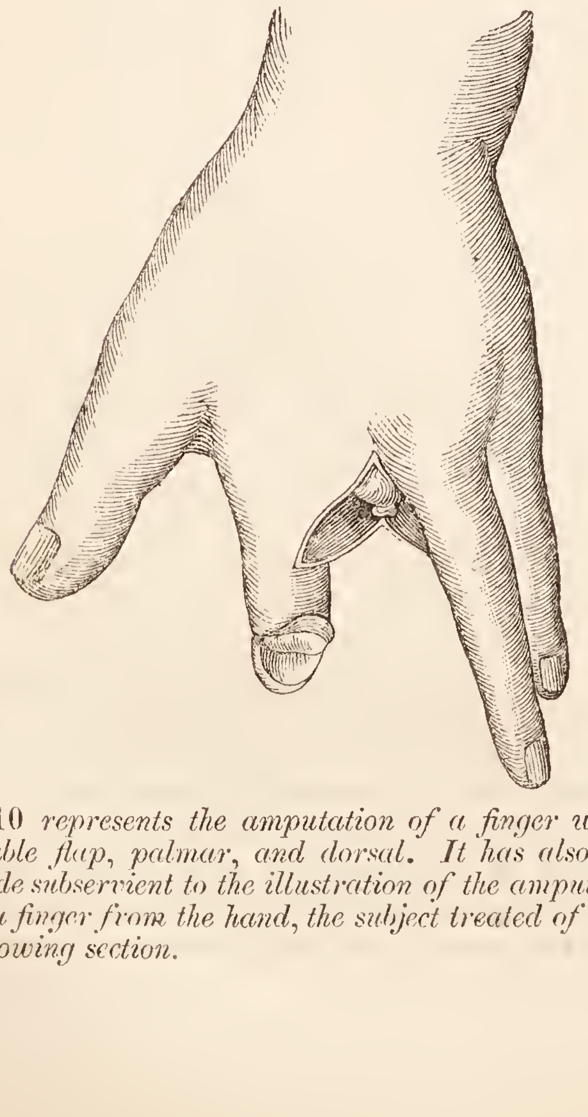

Fig. 10 represents the amputation of a finger with a double flap, palmar, and dorsal. It has also been made subservient to the illustration of the amputation of a finger from the hand, the subject treated of in the following section.

The hæmorrhage is trifling and soon ceases, either spontaneously or by compression. The flaps brought into contact, by straps of diachylon, or isinglass plaster, one or two small compresses may also be applied to protect the stump, which should be kept cool; and the arm should be worn in a sling.

AMPUTATION OF A SINGLE FINGER AT THE METACARPO-DIGITAL ARTICULATION.

The form of the knuckle-joint is an *enarthrosis*, with loose ligaments. Owing to this disposition, the situation of the joint can be at once made visible by drawing on the finger. The space made between the two articular heads of the bones, if the phalanx be now bent, will disappear, becoming occupied by the rounded extremity of the metacarpal bone. In the healthy state, the articulation will be found about an inch, or somewhat less, above the commissures of the fingers, the prolongation of the soft parts here forming a sort of *web*. The flap and oval methods are best suited to this amputation.

Flap method.—The hand in pronation, one or two assistants support and remove the sound fingers out of the way of injury; the surgeon takes hold of the finger to be amputated, and ascertains in the manner described above, or by moving it, the precise situation of the joint. With a straight bistouri he commences his incision from a point three or four lines behind the joint, directing it towards the centre of the commissure, which it divides, and is then continued in the same direction in the palm of the hand, till it nearly reaches its transverse fold, beyond the joint. This incision divides the skin and cellular tissue. The edge of the bistouri now divides the rest of the soft parts in a direction from before backwards, to the articulation. The edge is then turned to the side of the joint, which it lays open, and traverses to the opposite side, dividing both the flexor and extensor tendons. This step is facilitated by carrying the finger in a direction opposite to that on which the incision has been made; while the assistant must be careful to keep the skin retracted towards the wrist. The corresponding flap is then formed on the opposite side, by cutting from the joint to the commissure, the knife grazing the bone of the extirpated finger on its passage from within, outwards.

This is an improvement, by Lisfranc, upon the plan of Petit and Ledran. Sharpe employed the circular method, which has since been unnecessarily revived by M. Cornuau.

The object of prolonging the incision beyond the joint, both on the palmar and dorsal surfaces, is that it enables the operator to divide all the fibrous tissues around the joint, without wounding the lips of the wound, and give a cleaner surface to the incisions; and he may save himself any embarrassment arising from the necessity of seeking for the joint, by drawing the finger firmly in the manner directed. Some surgeons think it better to make the incisions fall, not exactly on the centre of the interdigital commissure, but a few lines beyond; but unless the soft parts be very scanty, this rule need not be attended to: when these are abundant, the excess of skin would be liable to pucker, and impede the cicatrization by becoming turned upon itself. When the soft parts are cut close to the bone, the digital arteries alone will have been divided, the trunk remaining untouched. If the hæmorrhage should not cease by the coaptation and compression of the flaps, these two vessels may be twisted or tied.

Dupuytren, supposing that the anterior end of the metacarpal bone would, from its size, produce deformity and inconvenience, recommended the removal of the finger by sawing the bone above the joint. But the idea is an erroneous one, and has not been adopted.

Petit's plan was to make both the incisions from without, inwards, or from the commissures to the joint, the joint being cut through by a transverse incision. The flaps by this method were more regular, but the modern method is by far more prompt.

Oval method.—The preliminary arrangements are the same as in the preceding mode. The surgeon commences his incision as before, three lines beyond the dorsal surface of the articulation, carrying it to the centre of the commissure, on dividing which the edge of the knife is carried along the transverse palmar line, that marks the junction of the finger with the palm of the hand, to the opposite side of the finger, from which point it is again carried up obliquely to the back of the metacarpus, till it joins the commencement of the first incision. He now draws the finger towards himself, and thus widening the lips of the wound as much possible, he cuts the extensor tendon, lateral, and palmar ligaments; then bending the finger still more, he forms the flap by terminating his incision at the palmar line, over which the knife had already passed.

In the flap method, the lateral flaps cover the bone in its large diameter, which is antero-posterior (fig. 10). In the oval method, the flap is taken entirely from the palmar surface of the extirpated finger, and when not cut too long or too broad, fits the exposed surface easily and well. But it does seem as if carrying the incision along the palmar line of the finger in the first instance was altogether superfluous, seeing that when the head of the phalanx is disarticulated, the incision which completes the operation, by forming the flap, must terminate there. Another point in its favour is, that it does not require, as the former mode, to have any incision carried into the palm of the hand. It is, however, not so easily performed, and should not be attempted without that familiarity with the parts which frequent trials on the dead subject can alone give.

This plan is also applicable where more than one, or even all the fingers are to be amputated.

AMPUTATION OF THE FOUR FINGERS TOGETHER.

This amputation, which had been mentioned in some of the old works on military surgery, was first methodically described by Lisfranc, to whom we are indebted for finally establishing it as an advantageous operation. It is but an application to all the fingers of the hand, of the process described above, for a single finger. The hand being placed in pronation, the surgeon takes hold of the fingers in his left hand, his thumb and index finger holding the little finger close to the joint if it be the right hand, the index finger if it be the left. An assistant retracts the skin, and the surgeon commences his incision about three lines lower than the joint, with a convexity towards the fingers, carrying it across the back of the articulations, from one side of the hand to the other (*g*, *l*, or *g*, *m*, fig. 12). By this incision, the extensor tendons are laid bare; the assistant opens the wound by the retraction, and the flap is dissected a little, till the joints are exposed; the tendons are then cut on a level with the joints, and the lateral and palmar ligaments of each are divided in succession with the point of the knife. He now passes the blade in front of each phalanx, which he raises, one after the other, and forms his flap by following the palmar fold which separates the fingers from the palm of the hand.

When any of the fingers can be spared, care should be taken to protect them from being wounded by the bistouri. This object may be facilitated, by cutting on the palmar lines, in the first instance, to form the thick flap, then dissecting the dorsal one, and, lastly, opening the joints in succession from left to right.

Before the age of fifteen or sixteen, the ossification of the heads of the metacarpal bones being incomplete, they may be easily cut with the knife. This disposition will allow of the removal of the heads of the bones themselves, without any disarticulation of the fingers, and besides, give a larger flap.

The circular method, recommended by M. Cornuau for a single finger, is also employed by him and others for the removal of the entire. He first forms the palmar flap along the directing line into the articulations; he then forms the dorsal flap across the back of the fingers, a little above their commissures, dissecting up, and penetrating into the articulations; each phalanx is then disarticulated in succession.

Fig. 11.

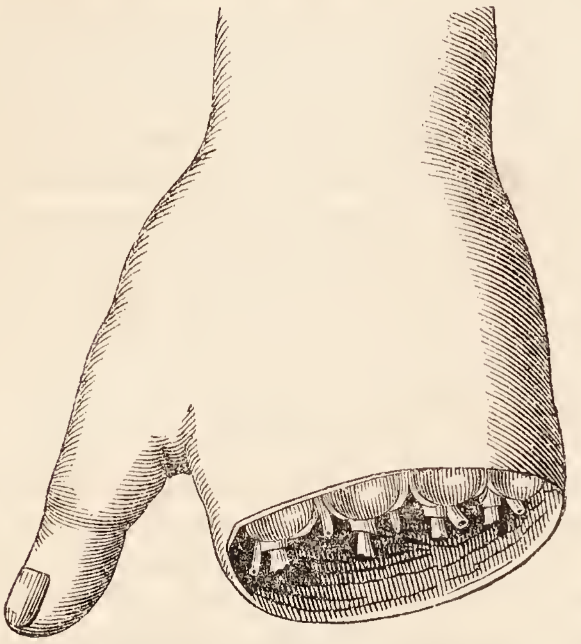

Fig. 11 *represents the amputation of the four fingers in their articulations with the bones of the hand; the ends of the metacarpals, with the divided tendons and blood-vessels are seen at the bottom of the wound.*

When the trunk of the digital arteries is not divided, the hæmorrhage will be slight, and easily commanded by compressive dressing. Should any ligatures be necessary, they should be carried out at the inferior or cubital angle of the wound. The lips of the wound are united by straps of diachylon or isinglass plaster. The continuation of the flexor tendons by sheaths, through the palm of the hand, and the loose cellular tracks having the same direction, make it a point of the utmost importance to take proper precautions against the propagation of suppuration upwards towards the wrist and fore-arm. The dressings in these cases must not be confined to the wound alone, but must include the palm of the hand also. Compresses should be placed judiciously, so as to prevent the fusing of pus upwards, and these should be secured by a roller, which will be made to come down from the fore-arm and wrist.

If inflammation should arise, the stump must be covered with leeches and poultice; and if, in spite of these means, pus is formed higher up, there is no time to be lost; deep and free incisions must be made to give it ready exit wherever it is found collected. The remedy is a severe one; but there is often no alternative but another amputation, or the loss of life itself.

METACARPUS.

The bones of the metacarpus may be amputated singly, or the four that support the fingers may be removed at once, each or all of the fingers which they support being extirpated with them. The operation may be performed, either in the continuity of the bones, or at the carpo-metacarpal articulations. Portions of them may also be resected; they may even be extirpated without entailing the loss of the finger with which they are continuous.

Fig. 12.

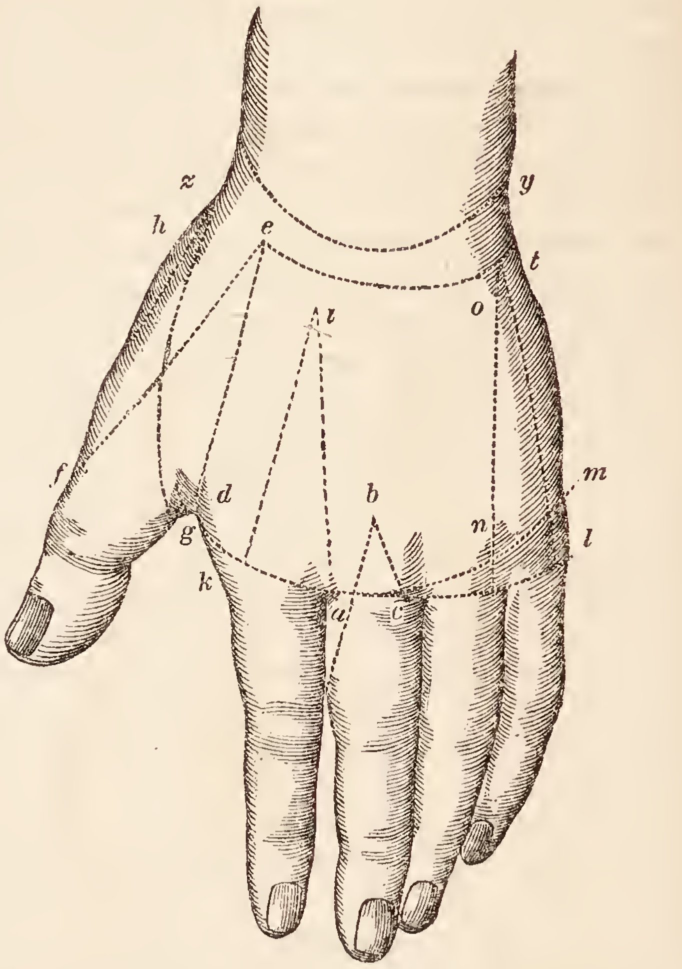

Fig. 12 *represents the lines of incision for the circular, flap, and oval methods of amputating the hand, either partially or totally: a, b, c, the two dorsal incisions in the oval amputation of the middle finger in its articulation with the metatarsal bone; the incision on the palmar surface runs in the digito-palmar line, and cannot be seen in this view; d, e, f, disarticulation of the thumb from the trapezium,* (see fig. 14,) *by the flap method; g, h, f, disarticulation of the thumb by the oval method* (fig. 16)*: the digito-palmar incision between g, f, is not seen; k, i, a, oval method applied to the disarticulation of the metacarpal of the index-finger, from the carpus: the incision in digito-palmar line not seen; n, o, l, the two dorsal incisions in the oval method for amputating the metacarpal of the little finger. The incision in the digito-palmar line, and which unites their extremities, is not seen; m, g, or l, g, the dorsal incision for the amputation of the four fingers together,* (see fig. 11)*; e, t, prolonged to z, dorsal incision in the amputation of metacarpals at the carpus; y, z, dorsal incision for amputating in the wrist-joint.*

Amputation of a single metacarpal bone in the continuity.—The hand being held in pronation, the surgeon transfixes it with a narrow and well pointed bistouri, from the dorsal to the palmar side, a few lines above the diseased or injured part. The point of the knife keeps close to the bone as it passes, the skin is drawn to one side, and the incision is directed along the edge of the bone, till it comes out at the corresponding commissure of the fingers. The soft parts covering the untouched side of the bone are drawn from it by the left thumb and fingers of the surgeon or his assistant; the point of the knife is again inserted at the top of the wound, but at the opposite side of the bone, and the soft parts being drawn off from it, the second incision falls into the same line, dividing them again down to the commissure of the other side of the finger. The point of the bistouri is used to make a track for the saw, clearing the bone at that part, of any shred of muscle, &c., that may remain attached. A small plate of wood or pasteboard is then introduced on one side of the bone, and a small saw at the other. The bone is then sawed in bevel or splice. Velpeau recommends the bone to be bevelled towards the ulnar side for the two last fingers, and towards the radial side for the two first. The index, middle, and ring-finger, are the best suited for amputation in the continuity.

Fig. 13.

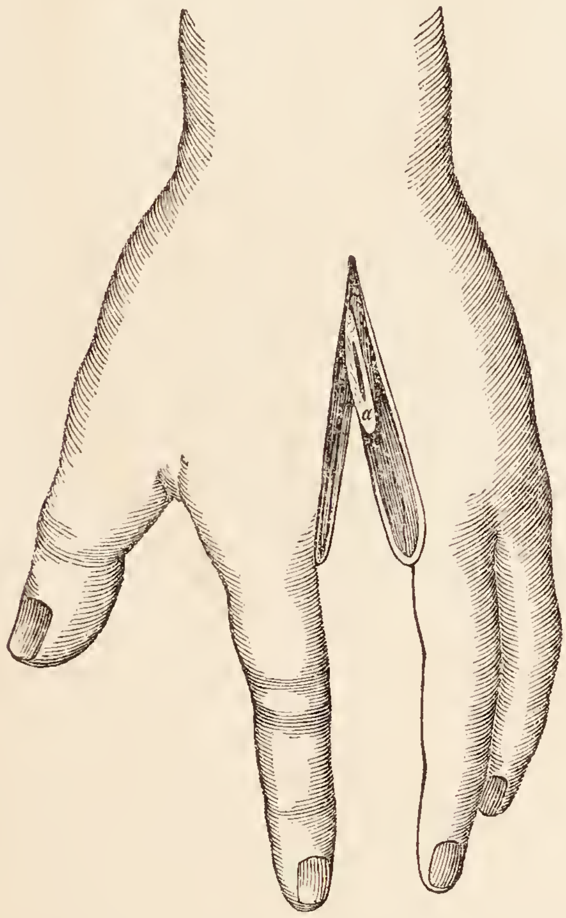

Fig. 13 *represents the amputation of the middle metacarpal; the bone*, a, *is cut in splice to allow the better coaptation of the sides of the wound. The deformity is scarcely perceptible after an amputation of this kind.*

The hæmorrhage may arise, either from the digital arteries, or from their trunk; when from the latter, the two divided extremities may require to be tied. In general, however, the coaptation of the lips of the wound, with even gentle compression, will be sufficient to arrest the bleeding.

Louis, in the case of a young girl, sawed off all the metacarpal bones at the middle. A flap with a semilunar edge towards the fingers was formed on the back of the hand; another in the palm, by passing a narrow bistouri, flat and close to the bones from one side of the hand to the other, and cutting downwards to the proper extent; the interosseous spaces were then cleared with the point of the knife for the saw, which was applied to each of the bones in succession.

AMPUTATION OF THE METACARPAL BONES IN THE CONTIGUITY.

Amputation of the thumb.—The thumb on its dorsal surface is so bare, that the articulation of the metacarpal bone with the trapezium may be easily felt, especially by bringing it close to the index finger. The articulation itself is separated from that of the index finger by a small bony projection from the trapezium. The joint formed between these two bones, a sort of arthrodial ginglimus with loose ligaments, is slightly concave from without inwards, with an oblique direction which corresponds with a line drawn from its outside, towards the root of the little finger.

Although there could be no impropriety in amputating the anterior part of the metacarpal bone of the thumb in the continuity, if the disease was confined to it, still its mobility is so extensive that its disarticulation is most commonly preferred, on account of the great facility with which it may be effected, and by whatever method the surgeon may think proper to adopt.

With one flap.—The hand being in pronation, the thumb is abducted from the fingers; the soft parts are retracted by an assistant. The surgeon applies the edge of the bistouri, with its point upwards, against the centre of the commissure, and striking at once towards the ulnar side of the bone, guides himself by it till he reaches the carpus (*g*, *e*, fig. 12). The incision is still further prolonged to the extent of five or six lines, both on the dorsal and palmar surfaces, in order to give greater facility for disarticulating the head of the bone from the trapezium. If the knife has not been kept close to the bone, it may reach the carpus on the other side of the little bony tubercle of the trapezium, and, in that case, the operator will be puzzled to open the joint. This difficulty will be avoided by making the incision in the manner described. The joint is opened by inclining the edge of the bistouri outwards, and all the ligaments are divided with its point. The head of the bone being now freed, the edge of the knife is brought out, and an external flap is formed by keeping as close to the bone as possible (*e*, *f*). The quantity of soft parts preserved will be still more considerable, if care be taken, in making the first incision, to incline the edge of the knife towards the ulnar side of the hand. The second incision is carried a few lines lower than the metacarpo-digital articulation.

Fig. 14.

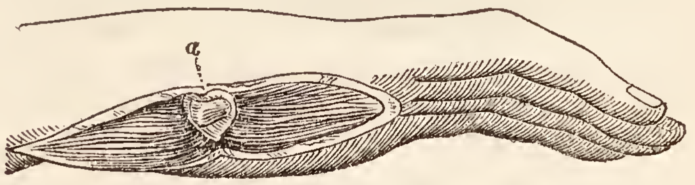

Fig. 14 *represents the amputation of the thumb with a single flap: the flap is thrown back against the side of the wrist:* a, *marks the articular head of the trapezium.*

If the radial artery has been divided, it will be found at the upper end of the second metacarpal bone, where it may be tied; if it has not been touched, the other small dorsal arteries of the thumb will, in general, cease to bleed upon the coaptation of the lips of the wound. It will be necessary to make use of a compress, after the adhesive straps are applied, in order to support the flap somewhat firmly against the second metacarpal bone.

Velpeau has often amputated, by making a dorsal incision from the styloid process of the radius to the middle of the commissure, and dividing at once the skin, extensor tendon, and a portion of the first interosseous muscle. The joint is thus laid bare at the first stroke. The assistant separates the lips of the wound; the articular ligaments are divided with the point of the knife, and the head of the bone being now luxated, the knife is carried under it, and the operation terminated by cutting outwards along its surface.

Fig. 15.

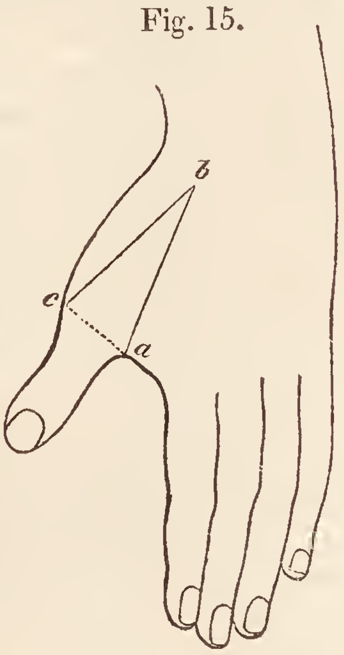

Fig. 15. *c, b, a, show the lines of incision for performing the amputation of the thumb by the oval method; the dotted lines, c, a, show the course of the incision by which their extremities are united on the palmar surface.*

The oval method is particularly well suited for this amputation. A dorsal incision, beginning a little above the articulation with the trapezium, is carried down till it terminates on the ulnar side of the first phalanx of the thumb (*b*, *a*). At this stroke the bone is laid bare. The hand is then put in supination, and the incision is continued round the root of the thumb, in the digito-palmar line (*c*, *a*), and is thus brought up (*c*, *b*) till it joins the commencement of the first incision. The articulation is then laid open, and all its ligaments divided with the point of the bistouri. The soft parts still adhering to the bone are then detached, by the knife being carried down till it joins the incision of the palmar line.

Fig. 16.

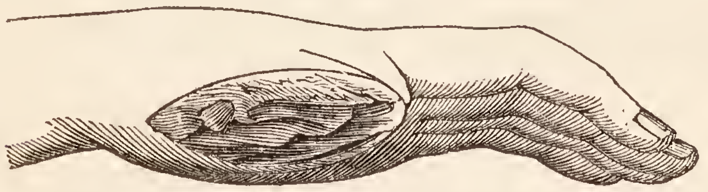

Fig. 16 *represents the flaps resulting from the oval method: the bone is seen at the upper angle of the wound.*

The oval, as a general method, is perhaps the best for this particular amputation. The cicatrix is linear, and the adhesion takes place with remarkable rapidity. But it is not so promptly performed as the amputation by flap, and it requires greater dexterity on the part of the operator.

When the metacarpal bone alone is diseased, modern surgeons have been successful in extracting the necrosed or carious bone, without involving the phalanges in the ablation. The process by which this is effected is not, strictly speaking, an amputation, but a resection; to which head the reader is referred for a description of the mode of performing it.

Metacarpal bone of the little finger.—Flap method.—This bone is united at its carpal extremity to the next metacarpal bone by a plane articular surface, protected by ligamentous bands; it also shares with it its articulation to the unciform bone. It may be discovered on the dorsal surface, by inclining it outwards, and feeling for the slight depression which corresponds with the articular interline, just in front of the pisiform bone.

This amputation may be commenced, either by first forming the external flap, or the flap may be formed in terminating the operation. If the surgeon prefers forming the flap first, the assistant draws the soft parts away from the back and palm of the hand, in order to preserve as much of the hypothenar eminence as possible. The bistouri is passed through on a level with the carpo-metacarpal articulation, and made to glide along the ulnar side of the bone till it arrives two lines lower than the commissure between the little and middle fingers, where the incision terminates (*t*, *l*). The little finger is then separated as much as possible from the ring-finger, and the edge of the knife is carried rapidly through the commissure, up the radial side of the bone (*n*, *o*), till it reaches the opposite side of the joint, enlarging the upper angle of the incision, by pressing the point of the knife on the dorsal and the heel on the palmar side of it. Some surgeons (among whom Lisfranc,) begin the second incision opposite the commencement of the first; the soft parts are so drawn away from the bone towards the radial side of the hand, that the point of the knife may easily be made to penetrate through the interosseous space, without again wounding the skin. The soft parts are then divided with a sweeping cut, which runs along the radial side of the bone, and terminates at the interdigital commissure. The ligaments of the articulations are then divided with the point of the bistouri, either from within outwards, or from without inwards, following the dorsal line, and the head of the bone is luxated, and at once removed. The steps of the operation may be reversed; but being essentially the same, it is unnecessary to go over the description again.

Fig. 17.

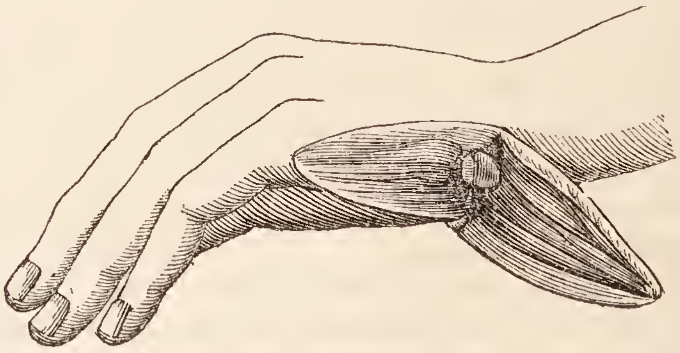

Fig. 17 *represents the amputation of the little finger with a single flap: the two articular surfaces, from which the head of the metacarpal has been removed, are seen at the upper angle of the wound.*

The oval method has been employed for this amputation by M. Scoutetten. The mode of performing is as follows: the hand being thrown into deep pronation, the surgeon begins an incision a little above the articulation, carrying it down in a straight line to the ulnar edge of the first phalanx (*t*, *l*, fig. 12); the edge of the knife then follows in the line which separates the finger from the palm of the hand, till it ascends between the little and ring-fingers, to join the first incision at an acute angle, (*n*, *o*). The soft parts are then dissected from the bone, and the ligaments divided in the manner already described. This operation cannot be executed with the same promptitude as the other, but it leaves only a linear cicatrix.

Amputation of the index, middle, or ring-finger, in the carpo-metacarpal articulation.—On inspecting the manner in which the heads of these three bones are so closely locked in, it will be obvious that the amputation of any one of them must be much more difficult than that of either of the two bones, we have been describing. That able operator, Langenbeck, however, recommends their removal, and performs the operation by the oval method. He begins his incision about half an inch above the articulation, carrying it down the dorsal surface, along the side of the bone, and turning the edge of the knife round the base of the finger in the palmar line, continues it upwards again on the back of the hand, and on the opposite side of the bone, till he reaches the point from which he first started. The interosseous, and articular ligaments are next to be divided with the point of the knife, gently, and without using any violence. This step of the operation is the most tedious, and will vary according to the bone to be removed. The form of the articulation should be carefully examined on the skeleton before the operation. The wood-cut accompanying the text will also help the memory. The assistant throws the lips of the wound as wide asunder as possible, and thus affords all proper help to the surgeon in his efforts to luxate the head of the bone. As soon as he succeeds in this, the knife, held flat, divides the parts in front of the bone, up to the commencement of the finger, where it falls into the incision of the palmar line. The cicatrix left is linear.

The operation may also be performed by commencing at the commissures, carrying the incisions upwards, at each side of the bone in succession, and luxating the head of the bone in the manner already described.

Simultaneous amputation of the four metacarpal bones supporting the fingers.—The mode in which the first and fifth metacarpal bones are articulated having been already described, we have now only to review that in which the other three metacarpals are connected with the bones of the carpus, and with each other. The space between the metacarpal of the index finger, and that of the thumb being large, their connexion may be said to be one of mere juxtaposition; its connexion with the middle metacarpal, on the other side, is intimate and strong; and a tubercle, of several lines in length, ascends with a like prolongation from the middle metacarpal, both wedging or imbedding themselves upon an indentation, which they make, respectively, on the two carpal bones, the trapezoid, and magnum. Their tubercles give insertion to two strong tendons. The second metacarpal is articulated with the trapezoid and the magnum; the middle metacarpal articulates in an oblique line, the direction of which is outwards, with the magnum; while the fourth articulates transversely in part with the magnum, and in part with the unciform, the articular surface of which it shares with the metacarpal of the little finger.

Fig. 18.

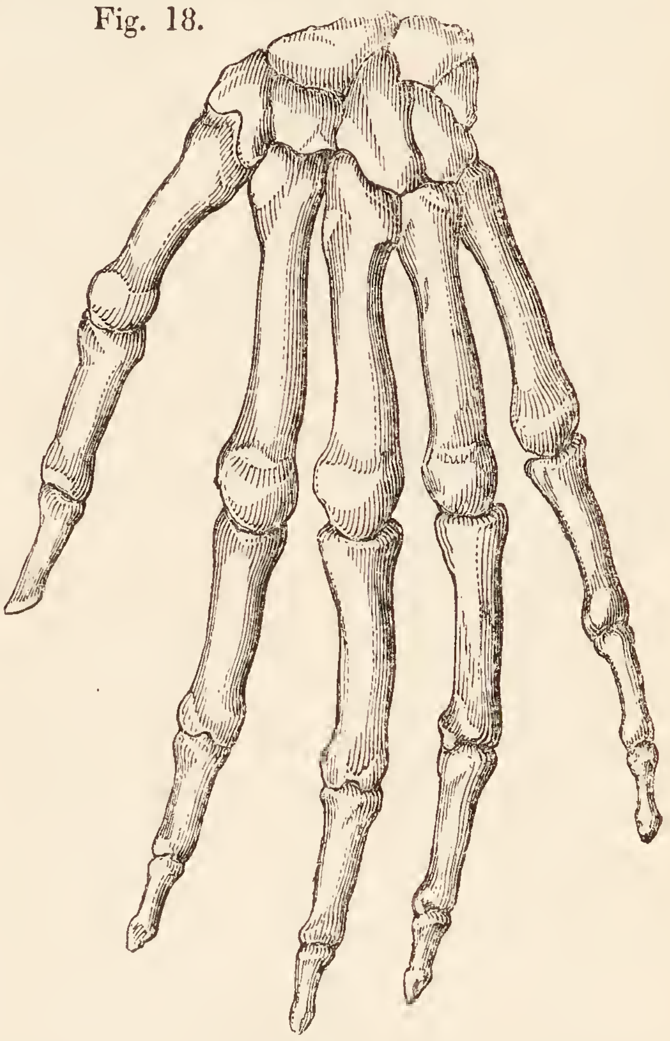

Fig. 18 *represents the skeleton of a hand with the forms of the articulations, and the courses of the articular interlines of the carpus.*

Though the whole line of these articulations is transverse, yet it is very irregular. To follow it from the thumb to the little finger, on the dorsal surface, (see skeleton of the hand, fig. 18.) we observe that of the thumb is directed obliquely forwards and inwards, and that it stops one or two lines further forwards than that of the index finger. The articular interline of the second proceeds, first, in a direction obliquely backwards, then transversely in front of the trapezoid, and then obliquely backwards again, to turn the tubercular prolongation. It then comes again obliquely forwards; continuing in this direction in front of the magnum, it reaches the fourth metacarpal, from which it passes in front of the unciform almost transversely.

All these bones are strongly bound together by dorsal and palmar ligaments extending from one to another in various directions. Their synovial lining is continuous with that of the bones of the carpus; on which account, inflammation arising after amputation may be attended with serious consequences.

Mode of performing the amputation.—An assistant commands the circulation in the radial and ulnar arteries ; the hand being in pronation, the surgeon takes hold of the four fingers, and forms a dorsal flap, with a convexity towards the fingers, a little more than half an inch in front of the articulations, beginning the incision on the radial, or ulnar side, according as he may have to remove the right or left hand, and carrying it quite across the back of it (*t*, *e*, *z*, fig. 12). The skin being retracted, the extensor tendons are divided on a level with the joints, and the surgeon, with the point of the knife, follows the line described above (fig. 18), laying open the backs of the articulations, but without making any attempt to penetrate into them. When they are all divided, he presses with a certain degree of force on the hand, and luxates the bones ; he now completes the division of the ligaments, and getting the knife on the flat, on the palmar surfaces of the bones, carves a semilunar flap of an inch or an inch and a half in length, by carrying it forwards and outwards.

This process may be reversed, by first forming the palmar flap, then the dorsal, and luxating the bones in the manner already described.

If only one or two of the metacarpals are to be removed, the method will then present a combination of the transverse dorsal and palmar incisions over the bones to be extirpated, and one or two longitudinal ones, as the case may be, beginning at the interdigital commissure, and ending at the head of the bone, to isolate them from those that are spared.

As a general rule, the amputation of the bones of the metacarpus, ought to be preferred to that of the wrist, when the disease or injury demanding it, does not extend to the carpus. This precept, however, is not laid down by systematic writers on surgery, nor has it been followed to so great an extent as it deserves, since it was first proposed. It is unquestionably an immense advantage to preserve a moveable portion of the member beyond the wrist joint. Since the idea was first broached at the beginning of the present century, the operation has been performed with success by Guthrie, Sully, Walther, Gensoul of Lyons, Troccon, and many others. In several cases on record, surgeons have not confined themselves, in these partial amputations of the hand, to the ablation of the metacarpal bones only, but have, at the same time, when circumstances required it, removed even one or more of the first range of the carpal bones.

Whenever the thumb is not irretrievably involved in the disease, the surgeon should make an effort to preserve it, as the variety and extent of its movements make it still capable of executing many of the functions of the hand.

All these operations require exact anatomical knowledge, and considerable dexterity on the part of the operator. He who has not acquired facility of execution by frequent trials on the dead subject, should be cautious in undertaking an operation, which, though simple, may embarrass him.

WRIST JOINT.

Of the four bones in the second or upper range of the carpus, three only enter into the composition of the wrist-joint ; these, counting from the thumb, are the scaphoid, the lunar, and the cuneiform. Together, they form a long oval, with a polished convex surface, which is received into an articular hollow of similar form, and concave also from front to back, prepared for it in the conjoined extremities of the two bones of the fore-arm, the radius and ulna. The styloid processes of these two bones are readily distinguished ; the articulation is placed a little below them.

The transverse lines on the palmar surface of the wrist, immediately above the palm of the hand, will serve as guides to the articulation. The first of these lines corresponds to the interline that runs between the two rows of the bones of the carpus ; the second, which is nearly half an inch higher, corresponds to the wrist-joint. Sometimes a third line is seen still higher up the fore-arm, which points out the extent of the epiphyses of the bones. Malgaigne furnishes other data for recognizing accurately the position of the joint. If the hand be bent strongly back, the summit of the angle, which it will thus form with the fore-arm, will correspond with the articulation.

Amputation of the hand at the wrist.—This operation is specially applicable, and, indeed, the most proper to be resorted to in those diseases which have spared the articulation of the wrist, and the soft parts surrounding it. The great success that has hitherto attended it has not, as yet, obtained for this mode the preference it is entitled to, over amputations in the continuity of the fore-arm ; and many surgeons still resort to the latter, notwithstanding the encouraging results obtained by surgeons of the highest merit. It is performed, either by the circular, or the flap method.

Circular method.—An assistant retracts the skin, and commands the circulation in the radial and ulnar arteries. The surgeon commences his incision, either on the dorsal or the palmar surface ; if on the latter, the edge of the knife runs in the line immediately above the thenar and hypothenar eminences. On reaching the upper part of the thumb, he turns the patient's hand, first semi-prone, then prone, carrying the edge of the knife across the back of the wrist, thus completing the circle. The skin being dissected back, and again retracted, the tendons are divided, and the knife enters the joint, either on the radial or ulnar side, guided by the styloid process ; the section of the capsular ligaments is completed, by cutting in a curved line from one side to the other.

The line in which the incision is traced leaves the pisiform bone on its palmar side, so that the operator cannot be embarrassed by it.

Flap method.—The old method of performing this amputation was to form two flaps, which may be accomplished in two ways :—

First,—The hand in pronation, a semilunar incision, extending from one styloid process to the other, with the convexity towards the fingers, carried across the hand, forms a dorsal flap (*z*, *y*, fig. 12). This is dissected up to the joint, the dorsal and lateral ligaments are cut through, and the joint is laid open, the carpus is luxated, the knife on the flat gets in front of the carpal bones, and a sufficient palmar flap is formed. It will be necessary to raise the knife at the side of the pisiform bone, to avoid including it in the flap.

Second,—The hand in semipronation, the surgeon passes a slender double-edged knife on the flat, across the front of the joint, from the styloid process on one side, to the same point on the other. Before penetrating with the knife, he relaxes the soft parts, as much as possible, by bending the hand on the forearm ; the protuberances of the scaphoid and pisiform bones are avoided by elevating the edge of the knife at these points : the hand is then extended, so as to level the soft parts, and make the flap more regular, and the knife is carried out, the surgeon cutting towards himself ; or the flap may be formed, by carrying the handle of the knife in a circular sweep from one side of the hand to the other, in such a manner as to form a long semicircular flap out of the palm.

The hand is then turned into pronation, and another semicircular dorsal flap is formed, and dissected upwards as high as the joint. The hand is then put into the semiprone position, and the edge of the knife, entering at the styloid process, makes a clear section of all the ligaments, and separates the hand from the forearm.

This plan is more prompt and brilliant than the preceding one; but the results of either of these plans are not so advantageous as those of the circular method, which consequently deserves the preference.

A single flap, taken from the palm of the hand will afford a sufficient covering, when the soft parts on the back of the hand are unfit to form a second flap. In such a case, it should be more ample in order to compensate for the want of the dorsal flap. It is unnecessary to repeat the directions for forming it.

The arteries to be tied or twisted are the radial and the ulnar; the hæmorrhage will often be arrested by compression alone. The interosseous artery is too small to require any particular attention.

Fig. 19.

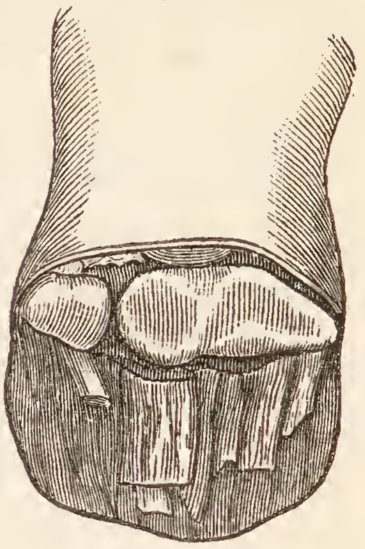

Fig. 19. *Amputation at the wrist-joint, with a single flap, formed from the soft parts of the palm of the hand, the hand itself in pronation; the articular ends of the radius and ulna, with the tendons of the flexor muscles of the fore-arm, are seen in the wound.*

Fig. 20.

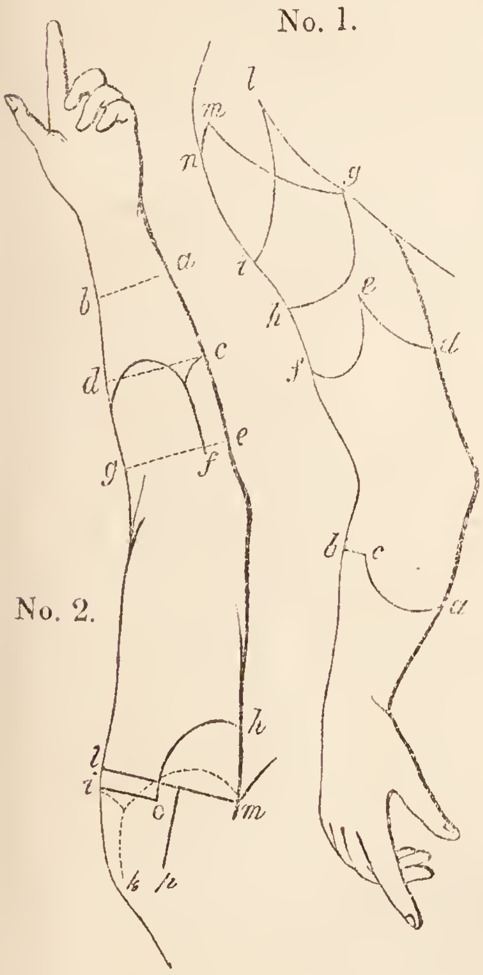

Fig. 20. *Front view of the arm and fore-arm, representing the lines of incision for amputations of the superior extremity, by the circular, flap, and oval methods. No.* 1, *b*, *c*, *a*, *single flap, fore-arm ; f*, *e*, *d*, *double flap at the lower part of the arm ; h*, *g*, *single flap from the outside of the upper part of the arm ; i*, *l*, *g*, *an external and internal flap for amputation of the arm at the shoulder-joint ; n*, *m*, *g*, *two oblique incisions, Guthrie's or Velpcau's method for the same.*

No. 2. *a*, *b*, *circular of the fore-arm ; d*, *c*, *the same higher up ; c*, *f*, *d*, *double flap in the thick of the fore-arm,—a portion only of the line of the external flap is visible ; g*, *e*, *circular incision for amputation at the elbow-joint ; i*, *o*, *h*, *a single flap from the inside of the arm,—circular and perpendicular incisions, or double flap, according to Hesselbach, for amputation at the shoulder-joint ; i*, *k*, *m*, *an anterior and posterior flap for the same disarticulation* (*Dupuytren*).

Fig. 21.

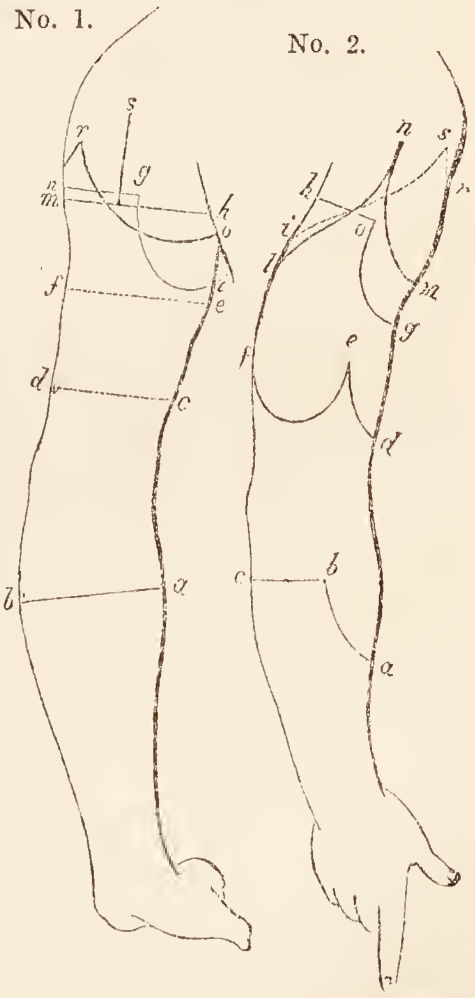

Fig. 21 *represents in lines, the various incisions made in the circular, flap, and oval methods of amputating on the fore-arm, arm, and shoulder.*

No. 1, *back view: a*, *b*, *circular method on the fore-arm; d*, *c*, *on the lower part of the arm ; f*, *c*, *middle of the arm ; n*, *g*, *i*, *single flap on the upper part of the arm ; m*, *h*, *s*, *disarticulation of the humerus, by the double flap, according to Hesselbach's plan ; r*, *o*, *Larrey's improved plan, a double flap, anterior, and posterior.*

No. 2, *back view, c*, *b*, *a*, *single flap, from the soft parts on the front of the fore-arm ; f*, *e*, *d*, *double flap at the middle of the arm ; h*, *o*, *g*, *amputation of the humerus, a single external flap ; l*, *m*, *n*, *disarticulation of the humerus by two flaps, according to Dupuytren's plan ; i*, *s*, *r*, *disarticulation with two flaps, Guthrie's plan.*

FORE-ARM.

Amputation of the fore-arm in its continuity.—Notwithstanding that the contrary opinion has been avowed by respectable authority, the general rule of removing as little as possible in amputations of the thoracic limb, is as applicable to the fore-arm as to any other part of the superior extremity. It is quite true, that the muscles, which are thick and full at its upper part, become gradually thinner, and more tendinous, towards its inferior third; but this change does not prevent the formation of a good stump, and there may be always a sufficiency of skin, the staple, generally speaking, of a good cicatrix, to cover the bones, tendons, &c. In this amputation, the circular, flap, and oval methods, are all equally applicable.

Circular method.—For this operation a slender bladed catling, and a three-tailed retractor will be required. There should be also two or three assistants; one to command the circulation, by compressing the brachial artery with his fingers against the inside of the humerus, or with a *garrot* and pad; another to support the diseased hand enveloped in a piece of linen; and a third, if he should be required, to hold the fore-arm, and be ready, as soon as the circular incision is made, to retract the skin. The fore-arm is presented in pronation, the surgeon takes hold of it above the place where he is about to cut, if it be the left arm—below, if it should be the right, and makes an incision all round, which will lay bare the fascia; the assistant retracts the skin to the extent of about an inch, or an inch and a half, the surgeon assisting him, by rapidly dividing the small fibrous bridles, wherever they impede the retraction. Another circular incision divides the muscles to the bone; these retract, and the knife is used to divide the interosseous muscular fibres, both on the front and back of the bones, together with the ligament extended between them. If the patient be very young, the knife used for this purpose must be slender. The retractor is then applied, the middle tail between the radius and ulna, and the muscles are thus drawn back and protected. We must not trust too much to the retraction of the muscles for forming a good stump; it should be borne in mind, that the muscles here are, for the most part, closely adherent to the bones. It is, therefore, highly important to preserve sufficient skin and muscle, without any reference to what may be gained by retraction. When a difficulty is found in dividing the muscles and tendons in the interosseous spaces, Cloquet directs the knife to be passed on the flat between them and the bones, and then turning the edge, to divide them transversely from within outwards. The periosteum being carefully cut along the track in which the bones are to be sawed, the surgeon commences sawing the bones, first on the radius, and then on the ulna, so as to saw both together. The radius ought to be sawed completely through before the ulna; as the latter, from being more largely articulated with the humerus, will serve to support it. Malgaigne recommends the middle position, between pronation and supination, for sawing the bones, in order that they may be divided on the same level with the muscles; for if the bone was sawn in pronation, the radius would project beyond the ulna in supination, and *vice versâ.*

Fig. 22.

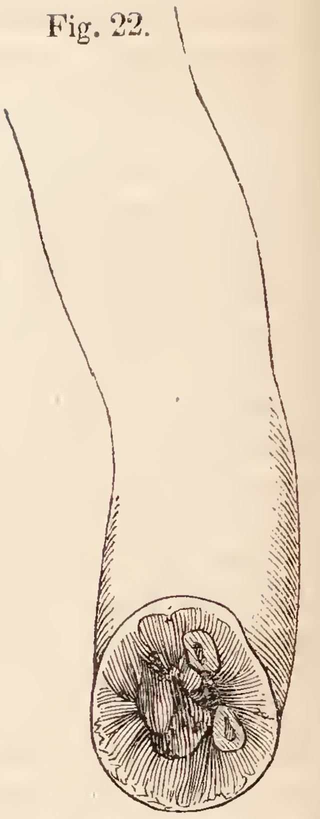

Fig. 22. *Circular amputation of the fore-arm* (*a*, *b*, no. 1, fig. 20); *the radius and ulna are seen, the one above the other, the fore-arm being semi-prone.*

The retractor is then taken off, and the two arteries sought for: the interosseous will seldom require a ligature. In tying the vessels, they should be carefully isolated from their accompanying nerves. The line of reunion must be the same as that of the bones.

Flap method.—Græfe performs this operation by forming a single flap from the anterior surface of the fore-arm. His mode of proceeding is as follows:—a thin knife is passed from side to side in the front of the bones, and a semi-elliptic flap is formed; the skin and muscles of the posterior surface are divided down to the bone by a semicircular transverse incision (*c*, *b*, *a*, no. 1, fig. 20). The soft parts are then retracted, and the bones are sawed in the usual way.

The plan with two flaps is preferred to it, and is performed, according to Vermale's method, at any part of the fore-arm. The fore-arm being in the middle state between pronation and supination, the anterior flap is formed first. The strongest objection to this plan arises from the liability of the two ends of the bones to protrude at the corner of the wound; an objection from which the circular method is free. It may, however, be observed, that

Fig. 23.

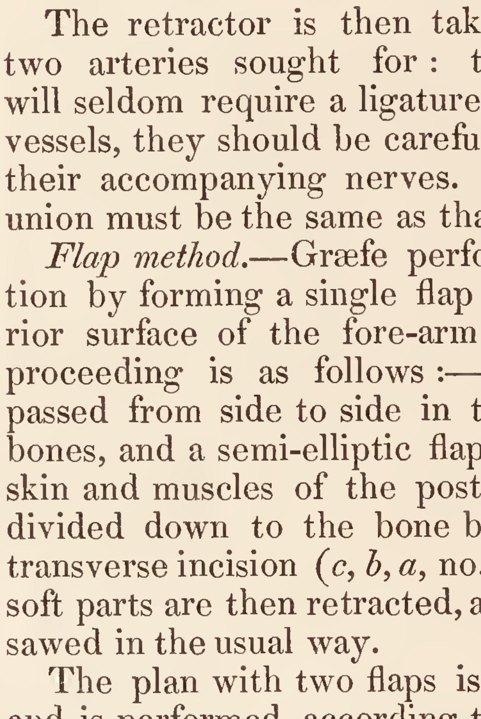

Fig. 23. *Double flap amputation of the fore-arm.*

though the circular be the best, as a general method, the other plans will be often of great value in particular cases.

ELBOW-JOINT.

Amputation of the fore-arm at the elbow-joint.—The objection to amputating in an extensive articulation, and the difficulty attaching to the performance of the operation are deemed, very generally, a sufficient reason for preferring the amputation in the continuity of the lower third of the humerus, to the ablation of the fore-arm, by penetrating into the joint. Setting, however, these considerations aside, we are ready to acknowledge, that it is a great advantage to save the lower third of the humerus; and that the operation has been attended with a fair average of success.

The precise situation of the joint is readily ascertained, by the lateral prominences of the three bones that form it. In front, the heads of the radius and ulna are nearly on the same level, and form a transverse line, interrupted only by the slight elevation of the coronoid process of the ulna; and hence the facility of carrying the edge of the knife, at one stroke, into the joint. The operation may be performed either by the circular or flap method.

With a single flap.—The fore-arm being in supination, and slightly bent, a long, slender, double-edged knife is passed on the flat, close to the bones and in front of the joint, transversely, beginning at the ulnar side, from a little below the tuberosity of the humerus on one side to the same point on the other; the edge of the knife being downwards, a flap is formed of about three inches in length, by cutting obliquely downwards and outwards. Another transverse incision, extending from one angle of the base of the flap to the same point on the opposite side, completes, by a semicircular sweep, the division of the skin and muscles at the back of the joint. The anterior flap is retracted, the knife enters the articulation between the radius and humerus, cutting the external lateral ligament, and disarticulating the radius; the point of the knife is then applied to the ligaments that connect the ulna and humerus; those of the olecranon are most accessible at the back of the joint.

Fig. 24.

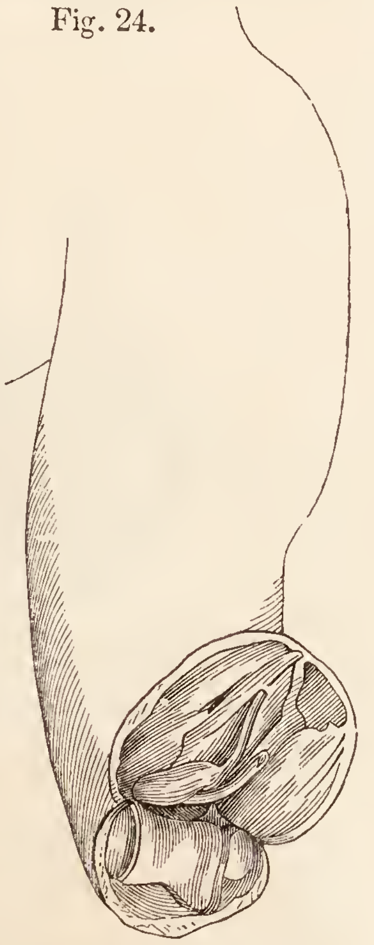

Fig. 24. *Flap amputation of the fore-arm at the elbow-joint, the flap taken from the soft parts on the front of the fore-arm; the articular surfaces of the humerus are seen at the back part of the wound.*

Dupuytren, in some cases, used to saw off the olecranon, although it does not appear that he had any very decided motive, either for adopting or omitting that step. It is quite certain that the triceps will still have the power of moving the arm after the olecranon is removed. Its removal gives more regularity to the stump, while it also diminishes the extent of the wound. The saw may be made to attack it, either from front or back. Brasdor used to form the posterior flap first.

Velpeau's plan combines the features of an amputation in the continuity and in the contiguity, as he removes the coronoid and olecranon processes of the ulna with the saw. In this way the operation is freed from the difficulties encountered in the disarticulation of the ulna, and the extent of wound is lessened.

Circular method.—The surgeon, standing on the outside of the arm, makes a circular incision, from an inch and a half to two inches below the joint, cutting down to the fascia; he then dissects the skin with its adipose membrane up to the level of the articulation. It is then retracted, or turned back by an assistant, and the muscles are cut down to the bones. The lateral ligaments are cut, and the bones are disarticulated, by pulling the fore-arm downwards; the point of the knife is made to turn round the olecranon, and the tendon of the triceps attached to it is cut through.

Velpeau gives a decided preference to the circular method in amputation of the fore-arm at the elbow-joint. In regard to the ligature of the arteries, it makes this difference—that there is but one to tie, the brachial; whereas, in the flap method, where the muscles are cut for three or four inches down the fore-arm, this artery is cut below its bifurcation. The wound which is made chiefly on cutaneous parts will also be more disposed to speedy union and less to suppuration.

THE ARM.

The humerus is a single bone, enveloped on all sides with muscles, except at its lower part. These muscles may be classed in three series: those that come from the trunk to be inserted into it; those that lie upon it without adhering to; and those that cover and adhere to it. The first are inserted into the upper part of the bone; the second into the fore-arm, and the last belong more strictly to the humerus itself.

Larrey objects, but seemingly without sufficient grounds, to amputation being performed at the upper part of the bone, preferring its total extirpation by amputating in the articulation itself. When the large muscles of the trunk are divided in amputating above the insertion of the deltoid, they certainly do retract to a considerable extent, and the supra-spinal muscles act without any antagonizing control; but notwithstanding this, the inconvenience which Larrey apprehends, the permanent extension of the remnant of the bone does not ensue.

The biceps being unattached to the bone, will, when divided, retract considerably, the triceps least of all. These points are important, and should be borne in mind. There is no point of the humerus at which amputation may not be performed. The place should be regulated by the extent of the disease, and the rule should be to perform the operation as low as it will allow.

A knife of middling length, bistouri, saw, and a two tailed retractor will be all that is required for the operation.

Circular method.—The patient is placed in a sitting posture, with his arm extended at a right angle from the trunk. The artery being compressed in the same way as in amputation of the fore-arm; the surgeon standing on the outside of the limb, if it be the right arm—on the inside if the left. The first circular incision divides the skin and adipose membrane down to the fascia. (*d*, *c*, or *f*, *e*, fig. 21). The assistant makes his retraction, and the skin may be turned inside out, or reflected for some way up the arm. The second incision made on a line with the reflected skin is carried clean through all the muscles to the bone. As the biceps will retract more than the other muscles, it may be divided alone, before the other muscles are cut. A third incision will divide the fibres attached to the bone, and which have retracted least. The radial nerve, lying to the external or posterior side of the bone and close to it, should be clearly divided in this last incision. The retractor is then applied, and the bone is sawed through in the usual way. The last incision of the muscles should, in general, be three inches higher than that which divided the skin. Some surgeons recommend a still further detachment of the muscular fibres, to the extent of an inch up the bone, in order to give additional security against denudation afterwards.

Fig. 25.

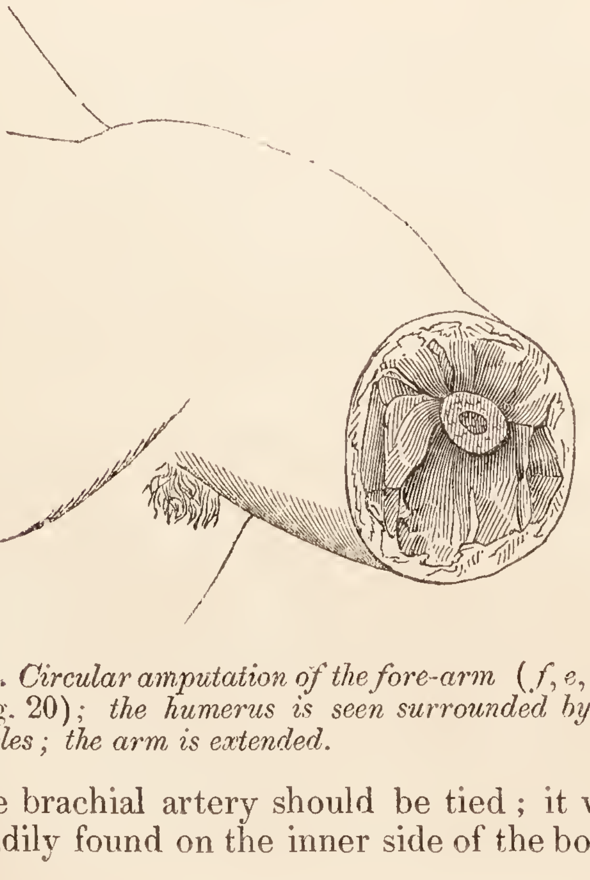

Fig. 25. *Circular amputation of the fore-arm* (*f*, *e*, no. 1, fig. 20); *the humerus is seen surrounded by the muscles; the arm is extended.*

The brachial artery should be tied; it will be readily found on the inner side of the bone, between the biceps and triceps, together with its two satellite veins, and the median nerve. If any of its branches bleed, they should be also tied or twisted. The cicatrix should form a line from front to back; or it may be oblique, and the lips of the wound brought together accordingly. Some surgeons unite by a transverse cicatrix.

Flap method—with a single flap.—Sabatier recommends the formation of a single flap, when amputation is performed on the humerus, above the insertion of the deltoid, on a level with the axilla. He forms a square flap out of the deltoid, by incisions, two longitudinal and one transverse. This flap being reflected back upon the joint, a semicircular incision divides the skin and muscles on the inside of the limb down to the bone, and the bone is sawed across. In this amputation, as there is no room for commanding the artery, either by manual compression against the humerus or by the tourniquet, compression should be made on the artery above the clavicle, against the second rib.

With two flaps.—(*f*, *e*, *d*, no. 2, fig. 20). This is a favourite method in Germany, having been put in vogue by Langenbeck and Græfe, the heads of that sect of surgeons not improperly named *Rapidists*, who place all the glory of an operation in the rapidity of the performance, and estimate its perfection in the inverse ratio of its duration.

The assistant, drawing the skin tightly up, the flaps are formed in the usual way, and may be either lateral, or anterior and posterior. They are cut to the length of three or four inches.

Fig. 26.

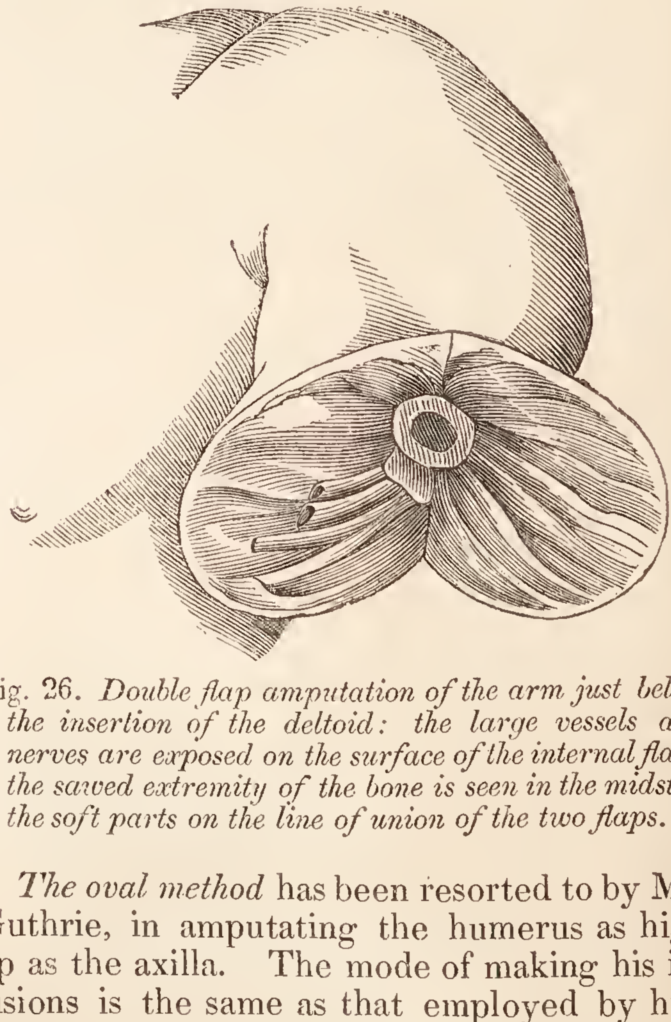

Fig. 26. *Double flap amputation of the arm just below the insertion of the deltoid: the large vessels and nerves are exposed on the surface of the internal flap; the sawed extremity of the bone is seen in the midst of the soft parts on the line of union of the two flaps.*

The oval method has been resorted to by Mr. Guthrie, in amputating the humerus as high up as the axilla. The mode of making his incisions is the same as that employed by him in his amputation at the shoulder-joint, except that the angle of the V does not ascend to the acromion.

The circular method for amputating the arm is preferable to any of the other modes, more especially when a sufficient quantity of integument can be preserved. In particular cases, however, as, for instance, when the skin has been extensively destroyed, the advantage may be turned in favour of the other methods.

SHOULDER-JOINT.

Fig. 27.

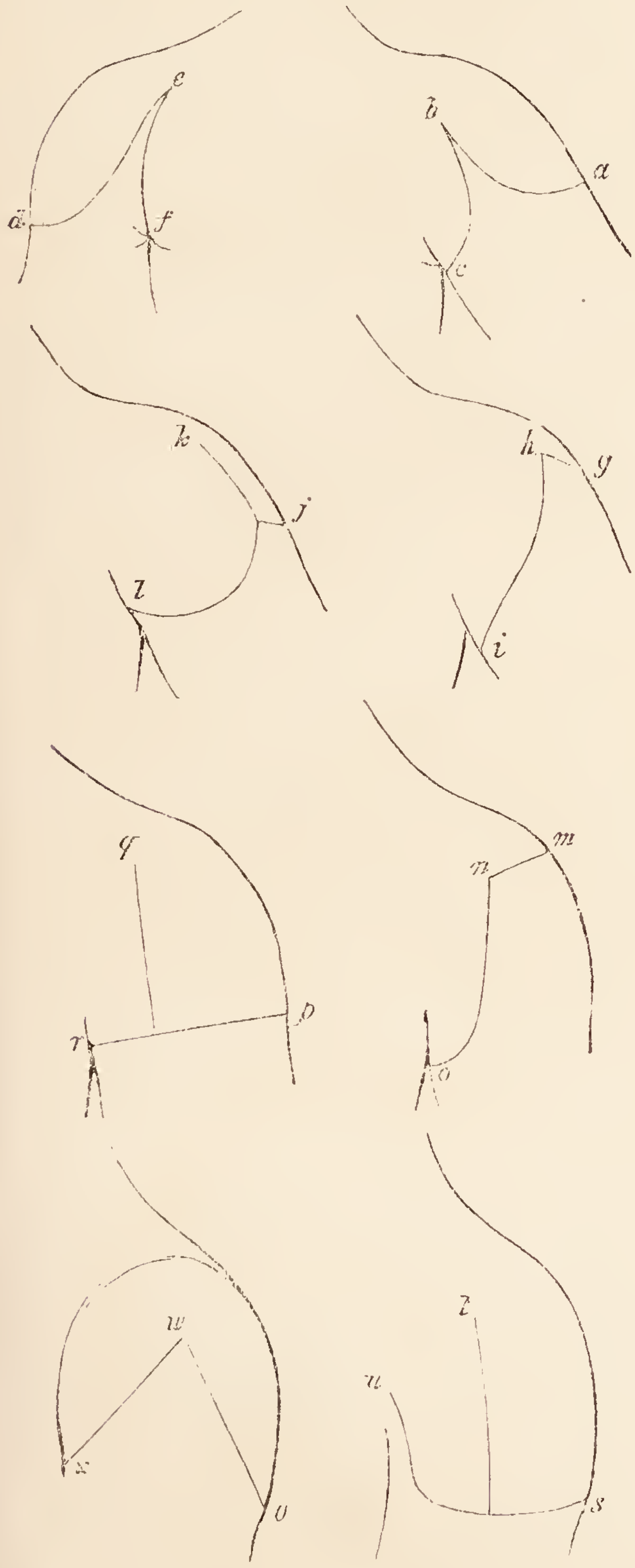

Fig. 27 *shows the lines of incision forming the flaps in amputation at the shoulder-joint, as performed by several eminent surgeons: a, b, c, double flap (Dupuytren); d, e, f, double flap (Lisfranc); g, h, i, double flap (Guthrie); i, k, l, double flap (Dupuytren); m, n, o, single internal flap (Ledran); p, q, r, circular and perpendicular incision (B. Bell); s, t, u, triple flap (Bromfield); v, w, x, the oval method (Scoutetten and Cornuau).*

This articulation differs considerably as to form and composition from any other in the body. The head of the humerus presents the form of a hemisphere, which is rather applied against, than fitted to the glenoid cavity of the scapula, not more than one third of it being received into that articular depression. A loose capsular ligament, attached to the circumferences of each of the articular surfaces, completes the articulation. Large muscles from the front and back of the trunk give strength and support to the joint, while two bony projections, the coracoid and acromion processes, united by a strong horizontal ligament, afford protection above. The half arch thus formed projects more than an inch beyond the glenoid cavity, and may serve as a guide to the articulation. These two processes often remain for a long time unossified; a circumstance to be borne in mind, on account of the facility it will afford the surgeon for disarticulating the head of the humerus in young subjects.

It will be gathered from this brief description, that the projection of the acromion and coracoid processes is at once a guide, and an obstacle to the operator; and that as they over-shoot the joint so much, it will be necessary to preserve a large portion of soft parts to cover them.

Amputation at the shoulder-joint.—The peculiarity in the form of the shoulder-joint, and the abundance of soft parts that surround it, have given rise to great variety in the modes proposed for the performance of amputation at this point. The circular, flap, and oval methods distinctively, or steps combined from all three have been employed, according to the fancy of the operators. Indeed, it may be said, for this amputation, that each surgeon has a method of his own. We shall only notice those most commonly practised.

With a double flap.—The flaps are formed variously, according to the modification of the flap method that may be adopted. All the modifications, however, may be reduced to two classes, according as the wound has a transverse or a vertical direction. Lafaye's plan, which was an improvement upon that of Ledran and Garengeot, is practised in the following manner:—The patient is seated on a chair, and the arm is held extended in the horizontal position. The surgeon makes a transverse incision on a line corresponding with the insertion of the deltoid. Two other incisions, one internal, from the tip of the coracoid process, the other external, from just behind the acromion, are carried down to the extremities of the first incision. A square flap is thus formed, which, being dissected up the articulation, is laid open. The capsular ligament is cut under the head of the humerus, which, on the arm being raised, is at once luxated. The operator thus obtains room to tie the axillary artery high up; which done, he detaches the arm from the trunk. Surgeons, at the present day, do not tie the artery before terminating the operation; they prefer stopping the circulation by causing the lower flap to be compressed by the hands of an assistant. The loss of blood is thus prevented fully as well, while the dismemberment is more prompt.

Dupuytren's plan differs from that of Lafaye in the manner of forming the deltoid flap.

The whole bulk of this muscle is grasped, and lifted from the side of the humerus; a double edged catling is then passed immediately below the acromion under the muscle, which it detaches, at a single incision, from the bone to the required extent (*b, a,* fig. 27). The arm is then quickly brought from the horizontal into parallelism with the trunk. By successive rotatory movements of the head, the tendons of the muscles round the joint are made tense and divided, beginning by those on the back of the joint. The head of the bone is luxated, the assistant pinches up the lower flap, and the limb is detached, as in Lafaye's method, by cutting the attachments of the pectoralis major, and latissimus dorsi, (*b, c,* fig. 27). This plan is more simple and expeditious than that of Lafaye, while its result is the same.

Fig. 28.

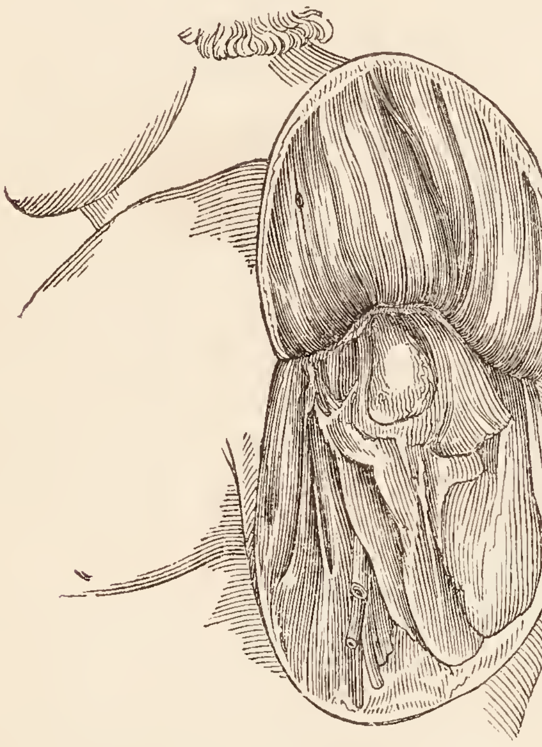

Fig. 28. *Double flap, a superior and inferior one, for amputating the arm at the shoulder-joint: the large vessels and nerves are exposed on the surface of the inferior flap; the glenoid cavity of the scapula is seen in the midst of the soft parts, a little below the line of junction of the flaps.*

The method of forming the deltoid flap may also be reversed. Mr. Cline used to cut the deltoid from its attachment up to the articulation, through which he passed the knife with amazing rapidity, and finished the incision by forming the under flap. In his operation, the whole seemed to be effected in one stroke. He made compression of the artery on the first rib. To do it well requires great habit; but it will be found more expeditious even than Dupuytren's.

Lisfranc's plan.—The patient is seated on a chair; one assistant stands behind him ready to compress the artery in the inferior flap, another at his side to reflect the deltoid flap. The limb is drawn slightly towards the trunk, or allowed to hang down. The surgeon, standing in front or at the side, passes the point of his narrow double-edged knife into the triangular space existing between the coracoid process and the anterior and outer edge of the clavicle, in a direction somewhat oblique from above downwards, passing under the acromion; before it reaches the axilla, the handle is raised as much as possible, so as to make the point come out very low down, and within the posterior border of the axilla. He then lays firm hold of the arm and draws it downwards, in order to separate the articular surfaces; the edge of the knife near the handle is next disengaged from the point of the acromion process by depressing it, cutting towards the coracoid process, and then directing the edge of the knife downwards on the outside of the arm, he forms a flap about three or four inches long (*e, d,* fig. 27), which is immediately reflected back by the assistant. In this first incision the articulation has been laid open; the head of the humerus is now raised, and the knife is passed through the joint to the inner side; the other assistant seizes the lower flap above the edge of the knife, makes a sign to the surgeon that he commands the artery, who then cuts on the inside of the humerus to form the lower flap (*e, f,* fig. 27).

This plan belongs exclusively to Lisfranc. It has also been reversed both by Champesme and Lisfranc himself. When the operation is performed according to this plan, the point of the knife is made to enter within the border of the axilla, the blade ascending obliquely, so as to form an angle of from 30° to 35° with the axis of the shoulder, the edge turned a little in front, and coming out in the coraco-clavicular space, in front of the acromion. The arm is then pulled downwards, and the point of the knife is pressed towards the coracoid process, so as to free it from the anterior point of the acromion; the flap is then formed as before.

The first mode will be most easily followed in amputating the right arm; the second may be employed for the amputation of the left. This operation is performed with great rapidity, and the disarticulation is easily effected, owing to the division, by the first incision of the tendons that cover the back of the joint.

With three flaps.—Larrey has performed amputation frequently in the shoulder-joint by the following method:—The arm being carried a little away from the trunk, the surgeon commences a longitudinal incision at the point of the acromion, prolonging it downwards in the middle of the deltoid, for three or four inches, and dividing this muscle into two equal parts, (*a, b,* fig. 27); the arm is then put in the horizontal position; and the knife is passed from the first incision, first behind the humerus, (*a, c*), then, in front (*a, d*), till the point, in both instances, shows itself within the corresponding border of the axilla; and two small flaps are thus cut, which the assistants immediately raise and reflect. The articulation thus laid bare above is opened, and the knife carried on the axillary side of the humerus; time being given for the assistant to command the artery, the inferior flap is formed in the usual way.

In forming the first two flaps, the circumflex artery may be divided; in that case, the assistant, who has charge of the flap, must stop the hæmorrhage by compressing it with his fingers, so that the surgeon shall not be diverted from pursuing the remaining steps of the operation.

Fig. 29.

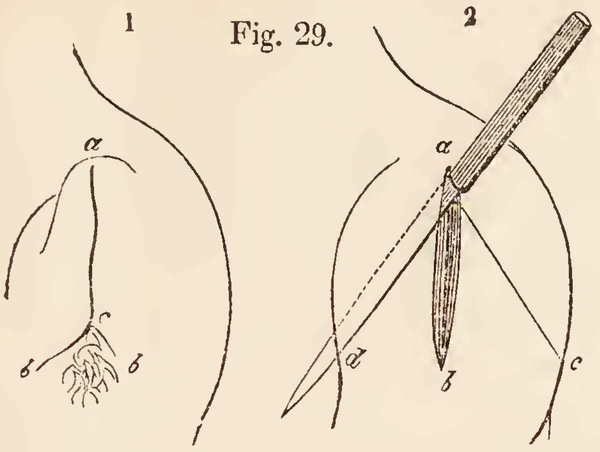

Fig. 29. *Larrey's triple flap for amputation at the shoulder-joint. No. 2 shows the lines of the incisions; No. 1, a, b, c, b, the wounds cicatrized.*

Oval method.—Mr. Guthrie has recommended this method of operating at the shoulder-joint. The operation is performed in the following manner :—As the two incisions (*i, h, y*, fig. 27) to form the V unite at the acromion, they are both begun from this point. The surgeon, placing himself outside the patient, carries the arm a little away from the trunk. He makes the first incision, at the back of the joint, directing the knife obliquely from the acromion, and carrying out the point within the corresponding border of the axilla, at its lower part. He then makes another from the anterior border of the axilla, to the point of the acromion. These flaps are both turned and held back, and the articular capsule is exposed at its upper and back part. It is then laid open and the head of the bone luxated. The knife is carried to its axillary side, and the assistant holding the artery compressed in his fingers, the separation of the limb is completed by cutting downwards; the basis of the V being thus the last part on which the knife is made to act.

Fig. 30

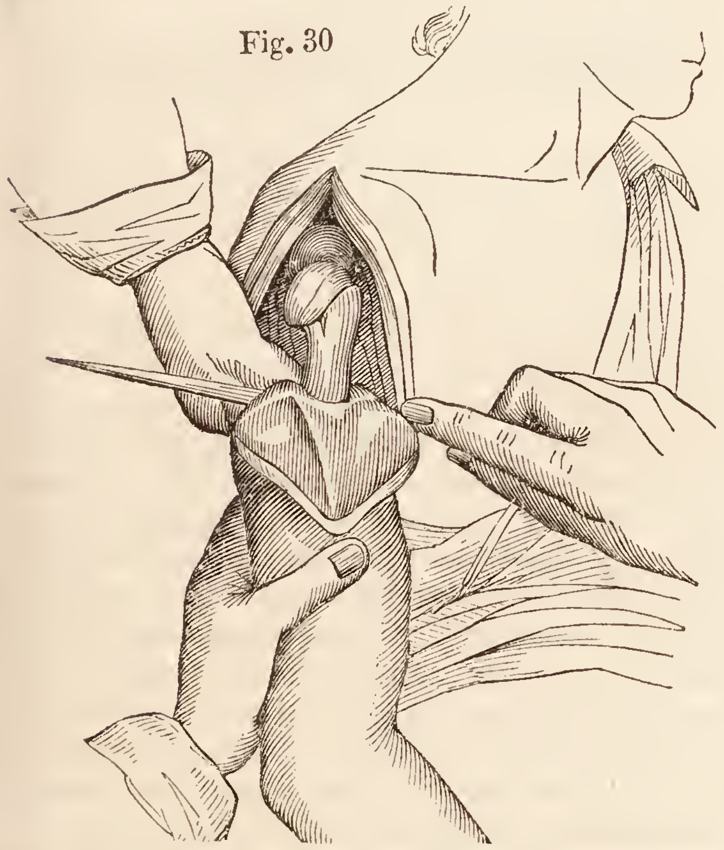

Fig. 30, *Mr. Guthrie's method of amputating at the shoulder-joint, modified by Velpeau. The head of the humerus is seen disarticulated, and the knife, carried to the inside, is ready to separate the limb from the trunk. The assistant's thumb, inserted deep into the wound, is compressing the artery, by grasping the flap between his thumb and fingers.*

Mr. Guthrie's method is also practised by making the incisions from the surface to the articulation; first, dividing the integument only, retracting it, and then cutting the muscles. When the shoulder is very full, this plan will afford additional facility. Velpeau alludes to a difficulty which is encountered in opening the capsular ligament, which, unless thrown on the stretch, yields before the edge of the knife, and remains undivided. It will be obviated in the manner already described, either by pulling the arm downwards, or by rotating the head of the bone, and tightening the capsule and tendons upon it. The oval method differs but little from the triple flap method of Larrey. If the circumflex artery is opened in the first incision, the assistant, in holding back the flap, must command it, as in Larrey's plan.

Circular method.—Alanson's plan for performing this operation is, an incision, which divides the integuments only, encircling the arm, between three and four inches below the acromion. An assistant retracts the skin; the deltoid is then cut obliquely from below upwards, until the articulation is reached; another incision opens the capsule, and cuts the tendon of the biceps. Arrived at this stage of the operation, modern surgeons cause the artery to be compressed before the soft parts in which it lies imbedded are cut. The capital fault of the circular method, as practised by Alanson and Garengeot, was that they previously resorted to the ligature *en masse*. This operation by circular incision is difficult; but the result, as regards a good stump, is perhaps the best that can be obtained.

The amputation at the shoulder-joint is not an operation of so modern a date as has been supposed. Laroque relates a case in which it was performed, in 1686, for gangrene of the limb :—" The surgeon had taken a small saw to amputate the humerus, but perceiving that it was loose in its articulation with the shoulder, he drew on it with some force, and the bone came out of its socket; after which, the boy recovered quickly." But though the idea of it might have frequently occurred, it was not put in execution till the time of Ledran. The simple method of commanding the axillary artery, by compressing it in the flap, has, doubtless, had a share in obtaining for it much of the favour which it enjoys at the present day. It cannot now be ascertained to whom we are indebted for this improvement; but it is mentioned by Pojet in 1759, and by Bertrandi in 1763.

From the great number of modifications of the different methods applicable to this amputation, it may be inferred, that although there is none which deserves an exclusive preference, yet, that each may possess advantages according to the nature of the case, which will render it more eligible than any other. With the general descriptions given above, the selection of the method, or the combination of different modifications best suited to the particular case, may be safely entrusted to the practitioner's own judgment.

For the prevention of hæmorrhage, the preliminary ligature *en masse*, as practised by Ledran and Garengeot, is now totally laid aside. The axillary artery is first secured, next the circumflex, and then any smaller vessels that are found to give blood. The dressing is performed in the usual way by the confrontation of the flaps, or lips of the wound. It should be rendered compressive from the trunk towards the stump, with a view to prevent pus from fusing in that direction.

SHOULDER.

Although the proposal to remove parts of the scapula or clavicle, when diseased, may seem a bold one, it has been effected, both by accident and by operation, without destroying life. Larrey has, in several instances, removed with complete success a large portion both of the scapula and clavicle. Mr. Cumming performed the entire ablation of the shoulder, in the Antigua Hospital in 1808, and the patient recovered perfectly. Many cases are also recorded, in which the shoulder was torn from the body by machinery, and the patients nevertheless recovered.

Whenever a portion of these bones is to be removed by the surgeon, he must trust to his experience and anatomical knowledge: to those resources, in a word, which qualify him for undertaking and carrying through a surgical proceeding for which no precise rule can be laid down, every step of which, from beginning to end, being dependent on the nature of the case. The preservation of sufficient soft parts to cover the stump well is an important point, and wherever it can be effected, by adhering to ordinary rules, the surgeon should be guided by them.

INFERIOR EXTREMITY.

Amputations are performed on the abdominal limb, either in the continuity or in the contiguity. The object, however, which recommends amputations in the contiguity so extensively in the thoracic limb, namely, the preservation of as much as possible, is by no means so imperative in the case of the lower limb.

Fig. 31.

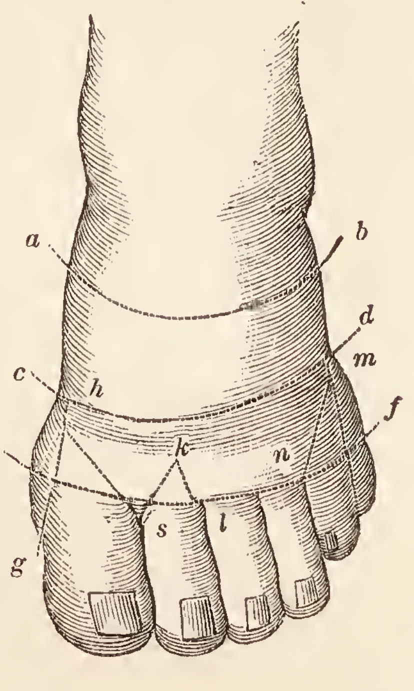

Fig. 31 *represents the lines of incision made in amputations of various portions of the foot: a, b, the dorsal incision for Chopart's amputation; c, d, the dorsal incision, for amputation of the metatarsal bones, from their articulations with those of the carpus; e, f, the dorsal incision for the amputation of all the phalanges; g, h, s, two oblique incisions for removing the great toe by the oval method; s, k, l, two similar incisions for the removal of the next toe; n, m, f, two oblique incisions for the amputation of the little toe; the prolongation of the line, m, f, shows the manner in which the flesh of the sole of the foot spreads beyond and under the toes. All these transverse lines appear nearer to each other, on account of the foot being foreshortened.*

Amputation of the first phalanx of the great toe.—When the disease affecting the ungual phalanx of the great toe has spared the soft parts on the plantar surface, and a sufficient flap can be formed, it will be proper to remove the phalanx only. The same rule applies as in the amputation of the first phalanx of the thumb, allowing merely for the larger size of the articular surfaces of the toe: to describe the mode of proceeding would therefore be a repetition.

Amputation of the toes in the articulations of the phalanges with the metatarsal bones.—The phalanges of the toes are so short, and their removal impedes so little the functions of the foot, that, with the exception of the great toe, the surgeon has no object in saving the first phalanx, even when the disease or injury is limited to the second, and he therefore performs the amputation at their articulations with the bones of the foot.

The junction of the toes with the metatarsal bones is marked on the dorsal surface of the foot by a depression. The transverse line on the plantar surface is also much deeper than in the hand, owing to the prominence or fulness of the sole of the foot, which advances here, as it were, under the toes. The same methods of effecting disarticulation are practicable, as in the case of the fingers; but their execution is not quite so easy. The oblique method is perhaps the best.

Fig. 32.

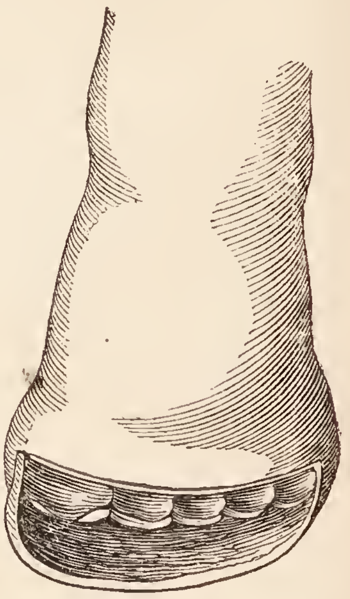

Fig. 32. *Lisfranc's plan for removing all the toes together; the ends of the metacarpal bones are seen in the wound; the flap is formed from the soft parts in the sole of the foot.*

Lisfranc's plan of removing the fingers by the flap method is applicable also to the toes, either singly or together.

Amputation of the great toe in its articulation with the metatarsal bone.—The propriety of performing this operation has been a subject of discussion. It has been urged on the one hand, that when the great toe is removed, it is difficult to obtain a sufficient covering for the head of the metatarsal bone, on account of its great size, and that the cicatrix is exposed to painful friction; and for these reasons, that an operation in the continuity of the metatarsal bone is much to be preferred. On the other, it is maintained that the head of the bone ought to be preserved on account of its importance to the due performance of the functions of the foot, and that its removal will cause the foot to turn in. With due care, however, in performing the operation, a sufficient covering can almost always be procured. If the disease did not extend as high up as the articulation, the surgeon might easily avoid the difficulty of procuring a sufficient covering for the articular head of the metatarsal bone, by amputating in the continuity of the first phalanx in the same way, as if he was operating on the thumb. The small sesamoids may be left in the flap.

Fig. 33.

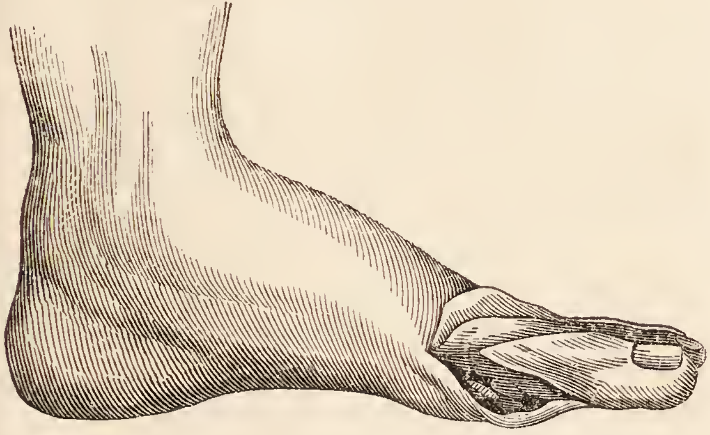

Fig. 33. *Amputation of the great toe in its articulation with the first metatarsal; a great part of the flap has been taken from the skin and soft parts on both sides of the toe.*

Amputation of the little toe in its articulation with the metatarsal bone.—Should the oval method be inapplicable the flap may be formed from the side of the toe, as in the accompanying figure.

Fig. 34.

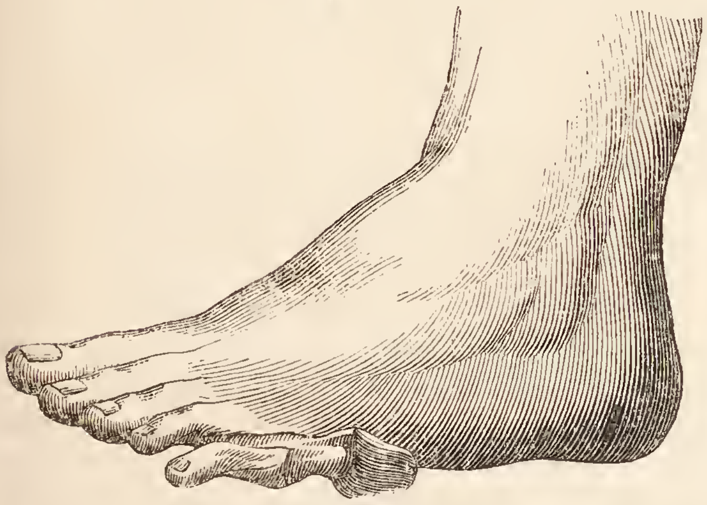

Fig. 34. *Amputation of the little toe in its articulation with the fifth metatarsal; the flaps taken from the skin and soft parts on both sides of the toe.*

Amputation of the metatarsal bones in the continuity.—These bones are more closely set together than their analogues in the hand, and hence a greater difficulty in using the saw, more especially on the three central ones.

Metatarsal bone of the great toe.—At the present day no surgeon thinks of attacking this bone in its tarsal articulation, for a disease which can be removed by sawing the bone in its continuity, particularly since Richerand's method of sawing it obliquely has put an end to the inconveniences which used to arise from its transverse section. Nor, on the other hand, does any one now maintain, that the metatarsal bones should be attacked in their continuity for a disease, which is removable by amputating at their articulations with the toes.

As was stated of the metacarpal bones, the metatarsal bone, supporting the great toe, has been removed, without extirpating the toe itself. But this class of operations belongs to the article Resection, to which the reader is referred.

The flesh is so unyielding under this bone, that it cannot well be pinched out into a bulky flap, allowing the knife to run down the side of the bone, as when we amputate the corresponding bone of the thumb; it will, therefore, be better to make an incision along the side of the bone, and penetrating to it throughout its entire length, until it reaches the phalanx; the soft parts are then detached from the dorsal and plantar surfaces of the bone. These flaps are then held back towards the fibular side of the foot, so as to allow the knife to pass, at the upper part of the wound, into the interosseous space without wounding the edges, either above or below the foot; the knife is then carried rapidly along the inside of the metatarsal bone, until it comes clear out at the interdigital commissure. The bone is next cleared of the soft parts still adhering to it, and a peace of wood, pasteboard, or a linen compress in several folds, being placed in the angle at the upper part to protect the foot, the saw is carried through the bone, in an oblique direction from within outwards and forwards. The arteries are tied, the flaps brought together, and a compressive dressing applied.

Fig. 35.

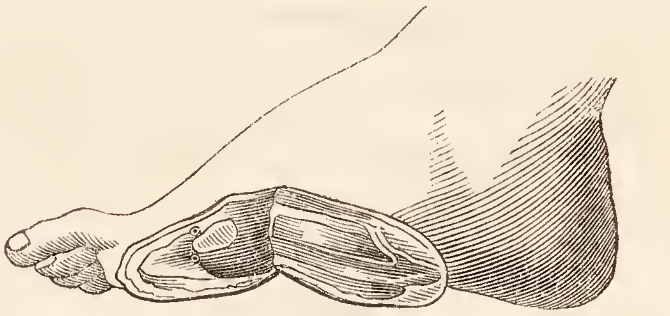

Fig. 35. *Amputation of the metatarsal bone of the great toe in the continuity; the flap is thrown back towards the heel, and the bone is seen sawed in splice.*

Oval method.—When this method is resorted to, as it almost always is, a dorsal incision, beginning at the upper part of the bone, is carried down to the digito-plantar line that marks on the plantar surface the junction of the toe and sole of the foot; the incision continues in this line, till it reaches the commissure, which it divides, and ascending on the inside of the bone, joins the first incision obliquely, a little below the point where it commenced (*g*, *h*, *s*,—*s*, *k*, *l*,—*n*, *m*, *f*, fig. 31). The soft parts are then detached from the bone above, and it is sawed obliquely through, as before.

Amputation of the fifth metatarsal bone in its continuity.—The reasons that bind the surgeon to operate in the continuity of the first metatarsal bone no longer have the same cogency in the case of the fifth. Its removal at the articulation leaves but little or no deformity, the disarticulation is easily effected, and the portion of bone that would be preserved by operating in the continuity can be but of little use. If, however, the surgeon should prefer it, the bone should be sawed in splice, in the same manner as recommended for the first metatarsal (fig. 35).

Fig. 36.

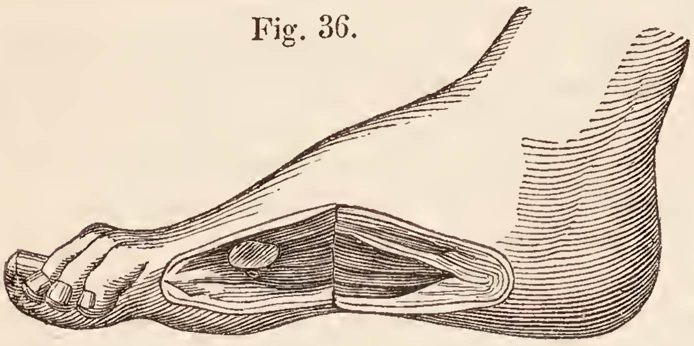

Fig. 36. *Amputation of the metatarsal bone of the little toe in the continuity; the flap is thrown back towards the heel, and the bone is seen sawed in splice.*

The oval method, performed as already described for the little finger, will be the most suitable.

Amputation of the middle metatarsal bones in the continuity.—The rules laid down for the removal of the metacarpal bones to which the reader is referred, are again strictly applicable to the metatarsals. The bones are to be sawed off, one after the other, and the same precautions should be taken to prevent the fusing of pus along the tendinous sheaths.

Fig. 37.

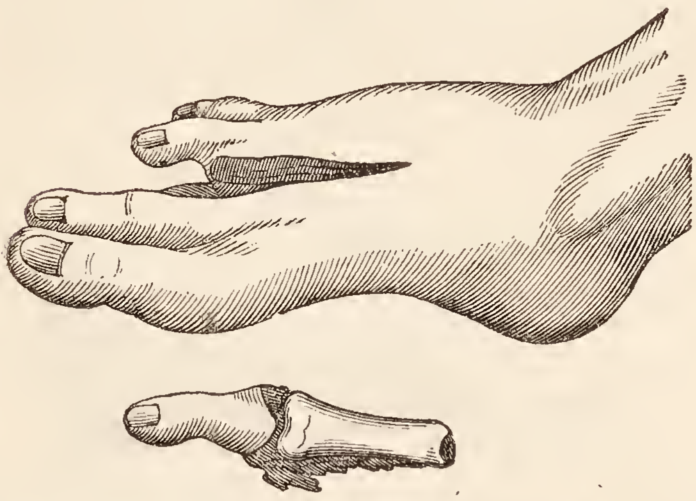

Fig. 37. *Amputation of the middle metatarsal bone in the continuity. The small fig. shows the bone and toe that have been removed; the bone has been sawed transversely, which is not so advantageous as the splice section.*

PARTIAL AMPUTATIONS OF THE FOOT.

Prior to the establishment of partial amputations of the foot as a rational surgical proceeding, the only resource for the lesions, which are now treated by this form of operation was the amputation of the leg itself; a resource involving the loss of all the sound parts between the place to which the disease was limited and the leg. The successful results of attempts to save the wrist, by partial amputations of the hand, at length opened the eyes of surgeons to the possibility of avoiding the unnecessary sacrifice of the ankle and heel. It was not, however, till the time of Chopart that the process began to obtain confidence.

Partial amputations of the foot are mentioned by Garengeot as performances of great difficulty, from the number and irregularity of the joints and ligaments.

These amputations are performed at two particular points: in the articulation of the astragalus and os calcis, with the scaphoid and cuboid; and at the junction of the metatarsal with the tarsal bones. Sharp and Hey were among the early advocates of these disarticulations; but, although they may have been executed by others prior to that period, the operation is first mentioned as having been successfully performed in this country by Mr. Turner of North Yarmouth, in 1787[1]. It was also performed in 1789 by Baron Percy, and in 1793 by Larrey.

Those, however, who had performed it successfully, described it vaguely, and almost in terms of discouragement to those who might be disposed to imitate them. In consequence of which, the partial amputation of the foot did not receive all the attention it deserved until the year 1815, when the presentation of an able memoir by Lisfranc to the Institute of France, made it a subject of discussion.

Fig. 38.

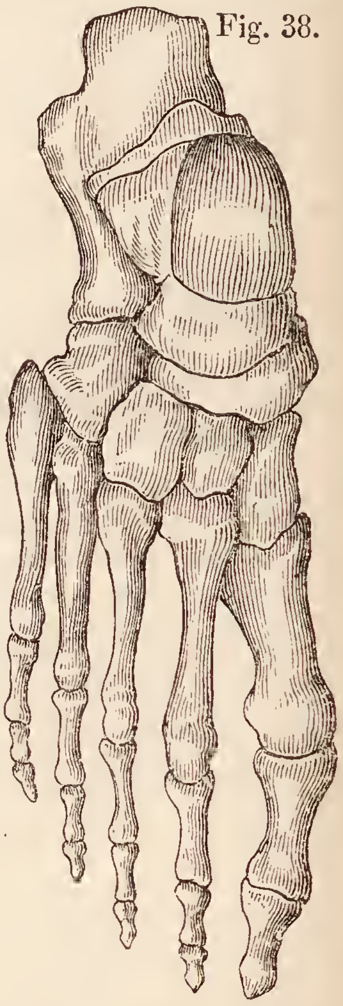

Fig. 38. *Skeleton of the foot. The articular interlines are shown very distinctly, and will serve as useful guides in studying the partial amputations of the foot.*

Amputation of the metatarsal bones in their articulations with the bones of the tarsus.—These articulations range the foot transversely, but in a line extremely irregular and intricate. The bones composing this line of junction are the three cuneiforms, and the cuboid on the one hand, with the five metatarsals on the other. The obliquity of the line is so great, that its commencement at the inside of the foot is nearly an inch farther forward than its termination on the side of the little toe. The prominence of the tarsal end of the metatarsal bone of this toe will serve as a guide to the interline that separates this bone from the cuboid. If a line be drawn from this point straight across to the inside of the foot, the interline separating the metatarsal of the great toe, and the cuneiform will be three-fourths of an inch further forward towards the toe. This interline will also be easily discovered under the skin, by feeling towards the sole of the foot for the two prominences formed, just at their junction, by the cuneiform and the metatarsal bones; the line between them is that of their articulation. From this point, if we trace the articular interline, on referring to plate (38) we shall see that it runs between these two bones with a double obliquity, first downwards and outwards, then upwards and outwards, and terminating against the side of the head of the second metatarsal, about four lines lower than its junction with the second cuneiform. To this extent it ascends directly backwards, between the side of the first cuneiform, and that of the head of the second metatarsal; it then proceeds transversely between the second cuneiform and second metatarsal, till it meets the third cuneiform, along the side of which, to the extent of two lines or a little better, it runs again directly forwards, with an inclination outwards. This encroachment of the second metatarsal upon the second cuneiform, forming a sort of mortice, is compensated for by a similar encroachment, in an inverse direction, of the third cuneiform upon the third metatarsal. The line then passes from the outside of the head of the second metatarsal, obliquely, between the third cuneiform and third metatarsal, and impinges upon the side of the head of the fourth metatarsal, and runs again directly backwards, between it and the outside of the third cuneiform; from this point it runs between the cuboid and the fourth and fifth metatarsals in a curve outwards, and obliquely backwards, and terminates behind the tubercle of the latter bone.

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[1] Hutchison's Practical Observations, p. 70.

Anomalies are also sometimes observed in the course of the articular interline; the bones may be more deeply morticed into each other, or, on the contrary, the mortices may be so shallow as to render the articular interline nearly straight. In this case there would be a corresponding facility in the operation. The tubercle of the fifth metatarsal has been known to be prolonged so far backwards as to join the side of the os calcis; sometimes the articular surfaces are ankylosed; and it should not be forgotten that the heads of the metatarsal bones, and the tarsal bones are not ossified to such a degree as to render section with a knife impracticable in young subjects up to the thirteenth or fourteenth year. The ligaments on the dorsal surface are short fibrous bands; the plantar ones are much thicker and stronger, and fill up the spaces between the bones; the interosseous are very powerful, and on that account are the most embarrassing to the operator. In order to be prepared for the difficulties of this operation, the surgeon should be ready to use the saw, when the point of his bistouri is insufficient to effect the disarticulation. Hey, in a case in which he operated in 1799, sawed off one-half of the large cuneiform bone; the head of the second metatarsal, if it was too firmly locked between the three cuneiform bones, might be left in the stump, by sawing it across in a line from the articulation of the first to that of the third metatarsal.

Lisfranc's method.—The knife or bistouri should be slender and have a solid back. If the surgeon is ambidextrous he will perform the operation with the right hand on the right foot, and with his left if the disease be of the left foot. If he uses the right only, he commences his incision, on the first or on the fifth metatarsal, according to the foot on which he has to operate. The patient is placed on a table or bed, in a sitting or reclining posture, the leg half-bent, and projecting beyond the edge of the bed. An assistant supports it, and, at the same time, keeps it turned inwards; another compresses the anterior and posterior tibial arteries, the former on the instep, the latter behind the internal malleole, while he also draws back the skin on the back of the foot. The surgeon, guided by the indications already given, ascertains the two terminations, external and internal, of the line of the articulations, and holding the foot in the palm of his hand, the thumb and index finger supporting the fifth metatarsal, if it be the left, the first if it be the right, he makes a semilunar incision, convex towards the toes, extending across the back of the foot, commencing and terminating at the two extremities of the articular interline. At this stroke, the integuments and cellular tissue alone are divided; these being retracted, the extensor tendons and other soft parts are divided by a second transverse incision, corresponding to the line of the articulations. The point of the knife is now employed in opening the joints, beginning behind the tubercle of the fifth metatarsal; after separating the fourth and fifth from the cuboid, the knife is stopped by the side of the third cuneiform; carrying the point a little forwards, it passes between the cuneiform and third metatarsal, and is again stopped by the side of the head of the second metatarsal. He then turns to the inside of the foot, and still using the point only, he separates the large cuneiform from the first metatarsal, until stopped by the head of the second metatarsal. The head of this bone, locked in between the three cuneiforms by strong ligaments, will hold firm until these are divided. The back of the knife is then inclined towards the toes, the edge towards the leg, and the point is passed between the first cuneiform and second metatarsal, until it reaches the depth of the articulation; the handle is then raised to the perpendicular, and the internal interosseous ligament is divided.

Fig. 39.

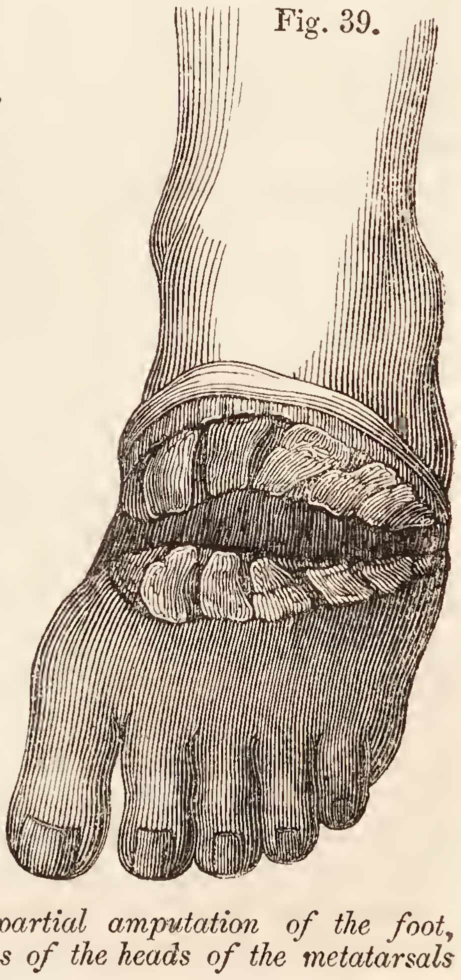


Fig. 39. *Lisfranc's partial amputation of the foot, in the articulations of the heads of the metatarsals*

with the tarsal bones. The metatarsals are luxated; and the anterior part of the foot is hanging by the soft parts of the sole, from which the flap is about to be formed.

By repeating the manœuvre at the top of the head, and at the other side, the strong ligaments are all divided, and this *key-stone* of the articular arch being freed, a slight pressure will throw downwards the anterior portion of the foot, and open wide the whole line of the articulations; the remaining ligaments are divided, and the knife is brought on the flat, between the under surfaces of the bones, and the sole of the foot. The point of the knife ought to be used for detaching freely the plantar ligament from the upper ends of the metatarsals, in order that the knife may lie well on the flat before the flap is cut. The inside of the flap should be two inches long—the outer, little more than one; its form must be slightly rounded to correspond with the semicircular curve of the upper part of the stump, and it should be cut out bevelled to the skin. If any tendons hang upon its surface, they must be cut clean off with a pair of strong scissors.

Fig. 40.

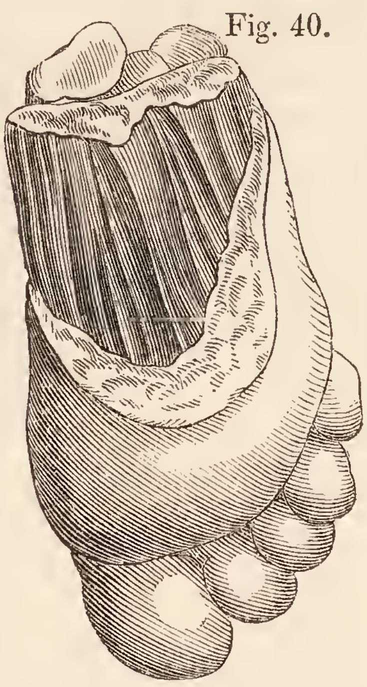


Fig. 40. *The foot removed shows the section of the soft parts of the sole to form the flap.*

The bleeding vessels are tied or twisted, the flaps brought together by adhesive straps, and the patient is placed in bed, the leg half bent, and resting on its outside, so as to favour the exit of any matter that may form in the wound. The same precautions to prevent the pus from fusing along the tendinous sheaths will be necessary as in amputation of the carpus. The bandages must be in a proper degree compressive from above downwards.

In casting an eye over the structure of tarso-metatarsal articulations, it will be perceived, that if only one or two bones are diseased, the ablation of the sound ones would be unnecessary. In a case, in which the cuboid bone was diseased, Hey disarticulated it from the os calcis, removing it together with the two outer metatarsals.

Partial amputations of the foot in the articulation of the astragalus with the scaphoid, and of the os calcis with the cuboid.—This operation is known by the name of Chopart's Amputation, and may be performed with much greater facility than the disarticulation we have been just describing. The joints here are much more loose and regular; the whole articular line is composed of portions, both tolerably regular, and easily recognised, on account of the degree of motion which the joint allows. The internal tuberosity of the scaphoid will serve as a guide to the articulation, which, on the inside of the foot, commences immediately behind this prominence. If a line be drawn from this point straight across the foot, it will fall on the articular interline also, just in front of another tuberosity, which can be felt on the outside and anterior point of the os calcis. The ligaments are loose and easily divided; the os calcis and the outer part of the scaphoid, are, however, held together by a very strong ligament, which forms what the French surgeons term the *key* of the joint. The direction of the scaphoid portion of the articular line represents a half-moon with an anterior convexity; that of the outer portion, an oblique plane from within outwards and a little forwards.

The foot is placed in the same position as for the preceding amputation, and the arteries are compressed as before. The surgeon, after having ascertained the position of the two guides to the articulation, takes the foot in his hand, so that the thumb and index-finger shall mark these points respectively, and makes a semilunar incision across the back of the foot from the one to the other (*a*, *b*, fig. 31).

Some surgeons recommend the incision to be made in the line of the articulation itself; but it is better to carry its convexity at least half an inch further forward. The assistant retracts, and the tendons are cut along the line of the articulation. If operating on the left foot, the point of the knife is at once made to penetrate the joint immediately behind the tubercle of the scaphoid, and following the articular line across the foot, completes the division of the dorsal ligaments. By pressing the anterior portion of the foot downwards, the joint is made to gape, and the division of the interosseous ligament is effected with the point of the knife. The bones are luxated, the inferior ligaments are cut, and the knife is turned on the flat in the soft parts of the sole of the foot, which is held in a horizontal position while the flap is cut from the inferior surfaces of the tarsal and metatarsal bones. The bony surfaces to be covered are considerable, and the flap should be in proportion. In general, three or four inches will not be too much. The flap should be somewhat longer for the inside, on account of the greater height of bone. In forming the flap, the protuberances on the plantar surfaces of the scaphoid and cuboid should be avoided, as well as those of the first and fifth metatarsal farther forward.

In persons of advanced years, the interosseous ligament is sometimes converted into bone, and a portion of the articular surfaces may be ankylosed; in this case, the small saw should be at hand to terminate the operation. Before puberty, on the other hand, the bones will be often found in the state of cartilage, or soft epiphysis, in which case the amputation might be performed without following the line of the joints, which might be left as far behind the section as the sound state of the soft parts would permit.

The arteries are tied, and the stump dressed, as in the preceding case.

Those who would execute properly both these amputations, especially the former, must possess exact anatomical knowledge, and that facility which is acquired by amputating frequently on the dead subject. Chopart's operation is much more easily performed; but the disarticulation of the metatarsals gives a more serviceable stump, and spares the tendinous attachments of several important muscles; and this is by no means an inconsiderable compensation for the greater difficulty of the operation. Whenever the disarticulation of the metatarsal bones will meet the necessity of the case it should be preferred. The same observation will hold good as regards Chopart's operation, which ought to be preferred to an amputation of the leg, when the disease has spared sufficient soft parts to form a good covering. It is, however, perfectly true, that in both, the tendons reunite with the stump, and re-establish the power of the muscles over its motions. Some cases have occurred after Chopart's operation, in which the heel has been so much thrown back, as to render the division of the tendo Achillis indispensable.

Fig. 41.

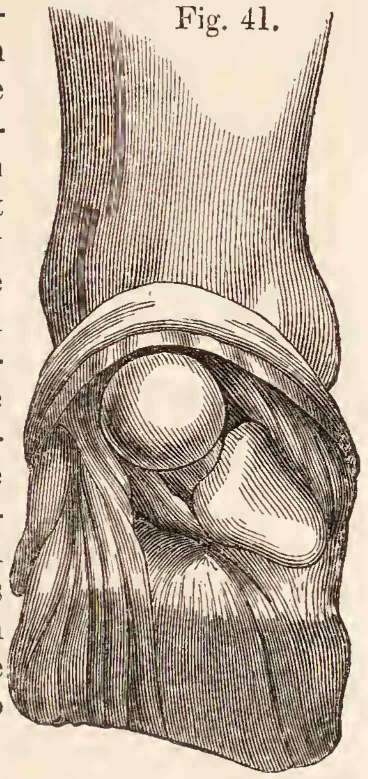


Fig. 41. *Chopart's amputation; the astragalus and os calcis are seen in the wound; the flap that has been cut from the sole of the foot is hanging down.*

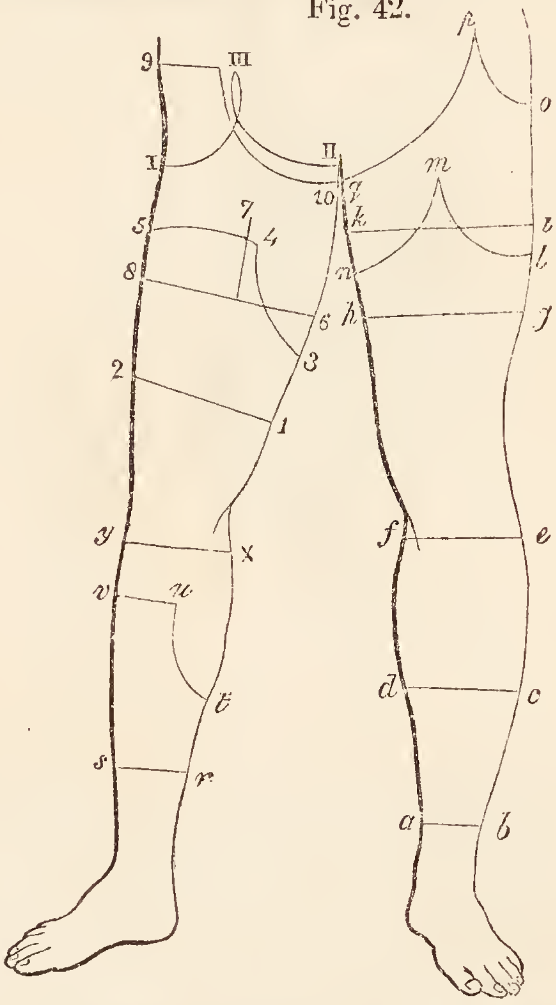
One or more of the tarsal bones have been extracted, and in some instances without impairing, to any great extent, the usefulness of the foot. The astragalus has been thus removed after violent luxation. But the mode of performing these operations cannot be reduced to any fixed rules, and must be left to the judgment of the surgeon.

ANKLE JOINT.

Mention has been made of amputation in the ankle joint at a very remote period. It is, however, seldom practised at the present day, amputation of the leg being generally preferred. Some eminent surgeons have expressed a regret that it should have fallen into such universal disuse. The objections made to it are the extent of the joint itself, and the scantiness of covering. Both these objections are, however, susceptible of mitigation: the extent of the articular surface may be diminished by removing both the malleoles with the saw, a step which will augment proportionately the capability of the soft parts to form a good covering for the stump.

The operation might be performed by making a short flap in front, by a semicircular incision extending from one malleole to the other. As the internal malleole descends less than the outer one, the joint should be opened on that side; the astragalus being luxated, the covering flap should be carved out of the soft parts of the heel. The removal of the malleoles would allow an ample covering for the stump. Lisfranc, in his lectures, mentions a man on whom this amputation had been performed who could walk ten or twelve miles a day with great ease.

Fig. 42.



Figs. 42,43 *represent the lines of incision in amputations performed by the circular, flap, and oval methods on the inferior extremity.* Fig. 42, *Front view: a, b, circular amputation above the ankle; s, r, the same; d, c, at the place of election; v, u, t, single flap at the place of election; y, x, amputation of the tibia in its largest portion, near the articulation, with disarticulation of the fibula; f, e, circular at the knee-joint;* 1, 2, *and g, h, circular at the lower third and middle of the thigh; l, m, n, double flap (Guthrie), upper part of the thigh; i, k, circular, upper part of the thigh; o, p, q, double flap, anterior and posterior (Guthrie, Lisfranc);* 6, 7, 8, *circular incision with double flap (Ravaton) at the upper part of the thigh;* 3, 4, 5, *single internal flap at the upper part of the thigh;* 9, 10, *single flap for amputation of the hip-joint;* I. II. III. *double-flap, internal and external (Larrey), for amputation of the hip-joint; the little elliptical space under* III. *indicates the line of incision first made, to secure the femoral artery.*

THE LEG.

In the leg there are two bones of unequal size, placed nearly in the same line; the larger, the tibia, being on the inside; the smaller, the fibula, on the outside, and somewhat backwards. Behind, the backs of both are covered with strong muscles; in front, the space between them is also filled with muscles. The inner surface of the tibia is covered only by the skin. The fibula also at its inferior part becomes subcutaneous. The soft parts diminish in bulk from above downwards, so that the limb tapers, both bones becoming comparatively divested of muscles, in approaching the ankle.

Fig. 43.

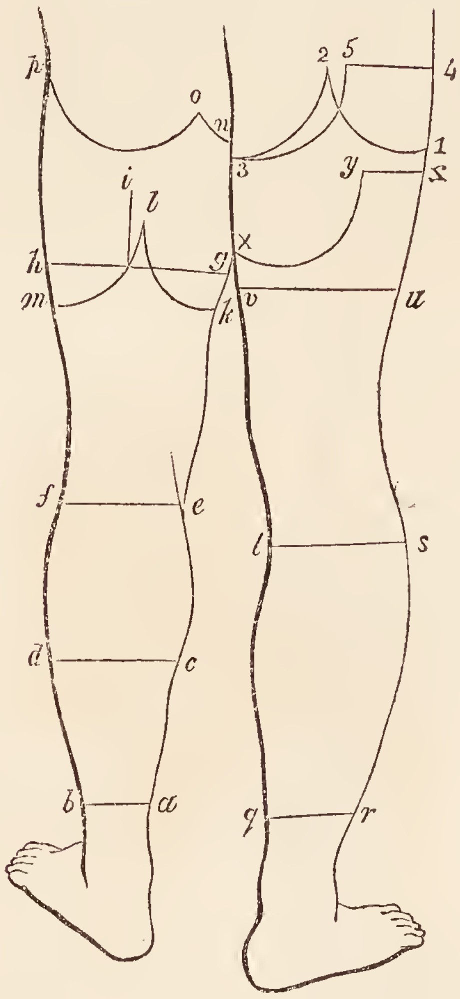


Fig. 43. *Back view: a, b, and q, r, circulars, above the ankle; d, c, circular at the place of election; t, s, circular amputation, in the broad upper part of the tibia near the articulation, with disarticulation of the head of the fibula; e, f, circular at the knee-joint; k, l, m, double flap at the middle of the thigh; u, v, circular, at the same point; h, i, g, circular incision with the subsequent formation of two flaps (Ravaton) at the upper part of the thigh; x, y, z, single internal flap at the upper part of the thigh;* 1, 2, 3, *double flap, internal and external (Larrey) for amputation at the hip-joint;* 3, 5, 4, *single internal flap for the same; h, o, n, double flap, anterior and posterior (Guthrie), for the same.*

Several circumstances concur to fix a place of election for amputating the leg. The preservation of the tendons of the flexors that bend the leg upon the thigh forbids cutting as high up as the tubercle of the tibia. The inconvenience of a too long stump, bent backwards from the knee-joint, to which in these cases, the artificial leg is adapted, forbids the section at the lower part of the limb. The place of election for amputating the leg is therefore fixed at four fingers' breadth, below the tubercle of the tibia, for an adult. But when the injury involves the place of election itself, many eminent authorities recommend amputation above this point in preference to an operation either at the knee-joint, or on the thigh. Larrey performed this amputation several times, even above the tuberosity of the tibia, at the same time disarticulating, instead of sawing the head of the fibula.

Mr. Guthrie approves also of this practice, of sawing the tibia in its broad spongy texture, near the articulations. For others, however, the place of election is much lower than we have stated, and even some have contended that the rule of saving as much as possible, is just as applicable in the leg as in the fore-arm. The cicatrix, it is true, is obtained, perhaps with equal facility; but the difference in regard to functions of the fore-arm and leg is altogether in favour of the former, while it is decidedly against the latter. If an artificial hand be adapted to the stump of the fore-arm, the cicatrix is not painfully pressed by it, and it produces no further inconvenience than what might be expected to arise from its weight, while it saves the free use of the elbow-joint; but the cicatrix in the lower part of the leg has to bear the weight of the body between the ends of two bones, and the pad of the artificial leg. The only circumstance necessary for the revival of the practice of amputating in the lower part of the leg is the possibility of securing protection for the cicatrix. The means hitherto employed for the purpose have not been, generally speaking, efficient; and in not a few instances, persons with these stumps have of their own accord solicited the performance of a second amputation higher up, to rid them of the evils they entailed upon them. Very possibly, however, this may be a difficulty which the art is destined to triumph over, by a skilful adaptation of mechanical means.

Amputation of the leg at the place of election.—Whenever there is room to perform it, and we have already stated, that the tibia may be sawed in its spongy head, as high up as the articulation of the fibula, this amputation is in all cases preferable to amputation of the thigh. In sawing the bone so high, however, some precaution is necessary, as the synovial membrane of the knee-joint sometimes descends a little over the front of the tibia. The ligament of the patella ought also to be spared both on its own account, and on that of the bursa mucosa which is placed behind it.

Circular method.—In the application of this method, the convenience, to the operator, of laying hold of the upper part of the limb regulates his position, either on the outside or inside of the limb. In general, he places himself on the inside; but he may also place himself on the outside, particularly if the right leg is to be amputated. The position on the inside of the limb is recommended, because in using the saw from that side, the fibula is first divided. As regards the section of the bones, this may be an advantage; but the division of the soft parts is matter of greater importance, and the rule ought to be to have the left hand above the section.

The circulation is commanded by an assistant, either with a tourniquet applied over the femoral artery in the usual situation, or with his fingers, a hand pad, or key, against the pubis. Compression of the artery in the popliteal space is uncertain.

The patient is placed on a table, or on the edge of a high bed; the limb to be removed is confided to the hands of another assistant.

The first incision commences on the outside of the spine of the tibia, is carried over the fibula, and terminates on the inside of the first bone, joining the point from which it set out. (*d*, *c*, no. 2, figs. 42, 43). The skin is dissected up for an inch and a half, and reflected, the fat outwards, so as to form a *bourrelet*, or sleeve. The second, proceeding as the first, divides the muscles, front and back of the bones, at the point where the skin is reflected. The interosseous muscles, with all the parts below the level on which the soft parts were divided by the second incision, still remain, and can only be cut by carrying the catling round each bone separately. As soon as this step is completed, a three-tailed linen compress is used to retract the divided muscles, &c., and the saw is applied first on the tibia, and then on the fibula, or rather on both together, and taking care to complete the section of the fibula first. Within the last thirty years, surgeons both in England and on the Continent have been in the habit of removing the spine of the tibia, which from its extreme prominency, is sometimes liable to become denuded in the stump. Beclard used to direct the first strokes of the saw upon it obliquely from above, downwards, for about half an inch above the point at which he intended to saw the bone transversely; he then withdrew the saw, and commencing the section below, so as to fall in with it, cut through both the bones in the manner already described. Messrs. Guthrie and S. Cooper, recommend this practice; but they do not insist upon it, perhaps, so much as it deserves.

The difference in the degree of retraction which the muscles in this part of the limb present in consequence of their being attached to bones, or free from such attachment, has suggested certain modifications in the manner of dividing them. The muscles situated in the hollow between the tibia and fibula, anteriorly retract but little: those situated behind the bones retract in proportion to the length of their fibres, and their freedom from attachment to bone. Sir C. Bell, keeping these points in view, recommends, first, an oblique section of the gastrocnemii muscles upwards, and then the complete division of the less retractile muscles on a level with the top of this incision. B. Bell, with the same object, repeats, for this amputation, the same caution that he gives in regard to the thigh and arms, viz. to detach the muscles for some way up the bones before applying the saw.

The arteries that will require a ligature are, the anterior tibial, which will be found in front of the interosseous ligament, associated with its nerve, and from which it must be separated before the ligature is applied; the posterior tibial artery; the peroneal; the gemelli, and sometimes the nutritious artery of the tibia. The arterial distribution here varies according to the height on the limb, at which the amputation is performed. When the operation is performed as high up as the tuberosity of the tibia, there will be but a single trunk to tie, the popliteal, with some articular branches, and the gemelli; in proportion as the bones are cut lower, we shall have the nutritious artery of the tibia, the posterior tibial, and the peroneal.

The lips of the wound are made to cover the bones either transversely or in a line from front to back. Richerand recommends an oblique reunion in the line of the two bones, a mode which combines the advantages of the other two. The stump should be slightly bent, and made to rest on its outer edge on a cushion.

Fig. 44.

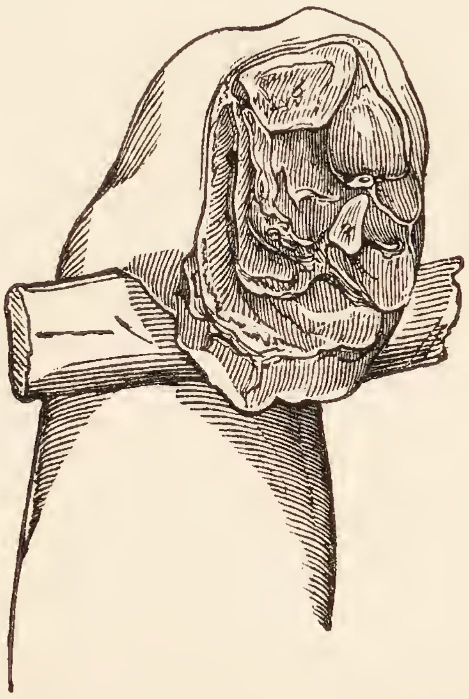


Fig. 44. *Circular amputation of the left leg at the place of election; the leg is represented, supported by a rail, with the face of the stump turned forwards, in the position it is usually presented in amputation, when the bleeding vessels are about to be tied. The tibia (marked b), and the fibula (marked a), are seen in the soft parts a little nearer to each other than natural, owing to the latter's having lost its support; the knee, and upper part of the leg are but little seen, being foreshortened in order to afford a fuller view of the face of the stump.*

Flap method.—This method, though first applied by Lowdham to amputation of the leg, is rarely resorted to by modern surgeons, except in cases where it presents the only alternative to an amputation of the thigh. It has numerous modifications; some surgeons form two flaps; others but one. Dupuytren used to form two flaps, the front one extending three inches down the tibia, the back one of the same extent, behind the bones; both were joined, according to Ravaton's plan, by a circular incision, and the flaps were dissected up to their base. The muscles of the interosseous space are then cut clean, and the bones are sawed in the usual way.

In Lowdham's plan, a single flap four inches long from the point where the bones are to be sawed, is formed out of the soft parts of the calf; the skin and interosseous muscles on the front or outside of the leg are divided by a transverse incision. The inconvenience, and frequently the excessive pain arising from the sudden turn which the base of the flap must make to cover the bones, render the operation by single flap ineligible, whenever it can be avoided. The oval method will obviate this objection, and ought to be preferred.

The *oval method* consists in an oval incision of the integuments, which are dissected and reflected back to the extent of two inches; and in a circular division of the muscles.

KNEE-JOINT.

The question of *amputation at the knee-joint* has been long regarded by the generality of surgeons as finally settled. Numerous successful cases, however, in which this operation has been resorted to of late years, either from necessity or the individual views of the surgeon, have again brought it under consideration. Some very eminent practitioners have thought that the amputation of the leg at the knee-joint has been too indiscriminately proscribed, while others, going still further, blame the timidity that has prevented surgeons from boldly penetrating into large articulations, and assert its superiority over amputation as performed in the continuity of the bones, either of the leg or thigh. The arguments against amputating in joints, especially of large size, have been laid down in the first division of the present article, and though we still adhere to our objections to these amputations, unless as exceptional proceedings, where an unusual prospect of success, or an unusual necessity might justify us in deviating from what we deem a safer course, still we see no reason against briefly stating the arguments of those who consider that this operation has been too lightly condemned.

They affirm, that so long as the periosteum of a bone, or the articular cartilage covering a bone, is uninjured, that no bad consequence can arise from exposure to the air, as these coverings afford a perfect protection against inflammation; that there is no synovial membrane spread over the cartilages; that it is almost always possible to save a sufficient quantity of the surrounding integuments to form a good and ample covering for the exposed condyles; that the wound is not so large as some imagine, the flap being formed almost exclusively of integument, which adheres most readily to the condyloid surfaces; and finally, that the disarticulation of the leg leaves not only a good stump, but that it preserves the mobility of the head of the thigh-bone in the acetabulum, which is lost when the amputation is performed in the continuity of the femur. When the amputation is performed at the knee-joint, the individual walks with an artificial leg, as if he had a stiff knee. But when the thigh is amputated, progression is by no means so free: he walks as if the head of the thigh-bone was ankylosed. The surgeon will make his own estimate of these arguments. The operation is performed in different ways, according to the method preferred.

AMPUTATION AT THE KNEE-JOINT.

Circular method.—An incision round the limb, at the distance of three or four fingers' breadth below the patella, divides the skin and subjacent adipose tissue down to the muscle, (*x*, *y*, fig. 42, or *f*, *e*, fig. 43); it is dissected up, and turned upon itself like a sleeve; all the thickness of the adipose tissue must be preserved to it. An assistant draws it upwards towards the joint; the ligament of the patella is divided, and the knife enters the articulation, cutting the lateral ligaments. The joint is now thrown open, the semilunar cartilages are detached, and the crucial ligaments cut. The operation is terminated by cutting down, at one stroke, all the soft parts of the ham, to the edge of the circular incision first made through the integuments. The popliteal artery, and any other small vessel that may give blood, are then secured; the parts are sponged clean, and the lips are brought together transversely, or in the direction of the large diameter, from one condyle to the other. They may also be united from front to back, in which case, the cicatrix would be shielded from pressure against the artificial leg, as it would thus be made to correspond to the depression between the condyles.

The circular method will in general be found to be the best; but cases may occur where, in consequence of disorganization of the integuments, it will be impossible to obtain a sufficient covering by any other than the flap method, which may be had recourse to, with one or with two flaps, according to circumstances.

With one flap.—Hoin used to perform this operation by extending the limb, and making a semilunar incision of the integuments, below the patella, beginning below the condyle on one side, and terminating at the other. The second stroke opens the articulation, cutting the lateral and crucial ligaments. The knife then turned on the flat, on the back of the tibia and fibula, cuts out the flap from the muscles and integuments of the calf. The danger of a denudation of the bone in this mode is much greater, as is also the difficulty of making and maintaining proper coaptation of the lips of the wound.

Fig. 45.

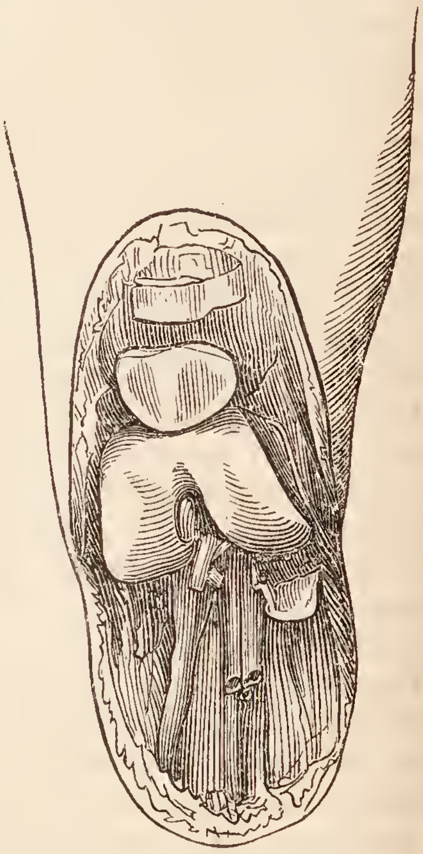


Fig. 45. *Amputation by double flap at the knee-joint; the anterior flap, containing the patella is reflected upon the thigh; the posterior flap containing the popliteal artery, vein, and nerve, is hanging down.*

With two flaps.—This proceeding, first resorted to by Mr. Smith, may also in certain circumstances be preferable to either the circular or the single flap method; for instance, where the soft parts on the back of the leg are so damaged that a single flap of the required length to cover the condyles completely cannot be obtained from them.

The oval method has also been proposed; but this as well as the flap method should merely be considered as modifications to be kept in reserve, and only to be had recourse to in particular cases.

THE THIGH.

The muscles of the thigh, like those of the arm, may be arranged into three classes also: the muscles that connect it with the trunk; those that stretch along it, without attachment, and are inserted into the bones of the leg; and those that cover and are attached to it. The form of the limb is somewhat conical, owing to the gradual diminution of the mass of the soft parts, from the trunk to the knee.

Possibly all the advantages of amputating at the knee-joint might be secured, and the objections obviated, by resecting the condyles in the spongy head of the bone, thus converting it into an amputation in the continuity, at the lowest possible point of the bone.

The muscles, as regards their retractility, may be arranged into two layers, a superficial, and a deep-seated one. The great length of the superficial muscles, and their freedom from attachment between the two points of their origin from the pelvis and insertion into the bones of the leg, favour their retractility in the highest degree. It will be obvious, therefore, that the lower down the limb the superficial muscles are divided, the greater will be their retraction. If then, in amputating the lower third of the thigh, we are to begin our circular incision four fingers' breadth below the point at which the bone is to be sawed, the application of the same rule in amputating at the upper part of the limb must rest upon a different principle. If the greater retractility of the superficial muscles, when divided at the lower part of the limb, requires the space of four fingers' breadth between the first section of the integuments and that of the bone, the greater bulk and depth of soft parts, and the consequently greater difficulty of properly confronting them in order to their reunion, will also render it necessary above. The principle, therefore, that regulates circular amputation, viz., to cut the layers in succession from the skin to the bone, each at a higher point than that of the layer last cut, and the bone itself highest of all, is specially applicable in amputation of the thigh. The retraction of the muscles will also be augmented, for those muscles which may, from the position of the limb, be thrown on the stretch during the performance of the amputation. When the stump is finally healed, this greater power of retraction in the superficial muscles has a direct influence on the position of the cicatrix, which is drawn inwards and backwards by the more powerful adductor muscles.

As there is no place of election for amputating the thigh, the rule of preserving as much as the disease or injury has spared, and of amputating as low down as possible, remains in full force. The danger of the operation in these cases, diminishes in proportion to the smallness of volume of the soft parts.

AMPUTATION OF THE THIGH.

Circular method.—The patient being placed on the edge of a bed, or on a table, the assistants, to the number of four or five are disposed in such a manner as to support the head, pelvis, and the sound limb; one takes charge of the leg to be amputated, supporting it on his knee, or a low stool, according to circumstances; another stops the circulation in the femoral artery, either with his fingers or a tourniquet. It is unnecessary to repeat the motives mentioned in the first part of this article for preferring, except under particular circumstances, the intelligent pressure of the fingers. The point of resistance against which the artery should be pressed is the pubic bone, where the vessel passes over it. Whenever the tourniquet is employed, it should be placed as high up the limb as possible. The instruments are placed in a tray within the surgeon's reach, or they may be handed to him according as they are required by an assistant.

The thigh being grasped firmly above the point where the incision is to be made, the skin and muscles are drawn upwards, and thus rendered tense and steady. The surgeon, standing on the outside of the limb, carries the knife to the inside of the thigh, the handle firmly grasped in the right hand, the point directed towards himself, and then at one sweep round the limb, beginning the cut with the part of the blade next the handle, divides the skin and adipose tissue down to the fascia. The incision penetrating beyond the fascia, is not a matter of importance, but it ought to divide the adipose tissue down to the fascia. The skin and adipose tissue are then retracted by the assistant, and if any bands oppose their ascent they are to be cut. Some surgeons, however, still adhere to the old plan of dissecting the skin up to the extent of an inch or more, and then retracting it, before they begin the section of the muscles, a plan which is more especially eligible when the amputation is performed in the upper and thicker portion of the limb.

Another circular incision, made at the line to which the skin is retracted, divides the superficial muscles; these being retracted in their turn, the deep-seated layer is exposed, and cut by a third circular sweep of the knife. A two-tailed linen retractor is next applied; the tails are crossed upon the cut surfaces, above the bone, the muscular fibres still adhering to the bone are cleanly cut, and the operation is terminated by sawing it four inches higher up than the point at which the skin was cut.

The lower the point at which the amputation is performed, the fewer will be the vessels requiring a ligature. At the lowest point, viz., four fingers' breadth above the condyles, the vessels requiring attention are the femoral artery, the anastomatic (*ramus anastomaticus*), with perhaps a few muscular branches which may be twisted. At the upper part of the limb, there will be, besides the femoral artery, the profunda, branches of the circumflex, obturator, and ischiatic arteries, and perhaps some muscular branches.

Fig. 46.

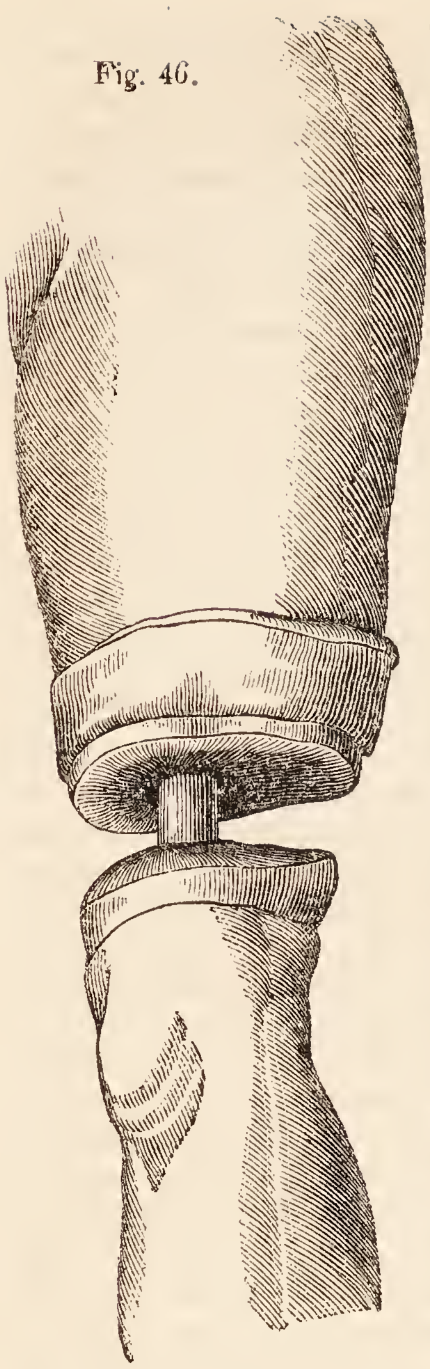


Fig. 46. *Circular amputation at the lower third of the thigh; the skin which was cut at the line just above the knee is seen reflected like a sleeve upon the middle part of the thigh. The muscles are divided down to the bone; and the operation is advanced to the point at which the retractor is to be applied, and the bone sawed through.*

The large nerves in the thigh, not being retractile like the muscles, are sometimes seen after amputation hanging, or projecting from the surface of the muscles. If left in this state, they render the dressing painful, and the stump less useful after the healing process is completed; it will, therefore, be better to snip them at once to the level of the muscles with a very sharp pair of scissors, or cut them with a quick stroke of the knife.

The sides and lips of the wound are brought together, on a line from one side of the thigh to the other, or from the front to the back. The transverse line of union is that usually preferred by the surgeons of this country. The French surgeons, who resort less frequently than ourselves to healing the wound by first intention, prefer the antero-posterior line of union, as the pus has a better drain from the posterior angle. Some surgeons unite the lips of the wound in an oblique line from without inwards and backwards, imagining thereby that they avoid the inconveniences of the two former modes of confronting the wounded surfaces.

Fig. 47.

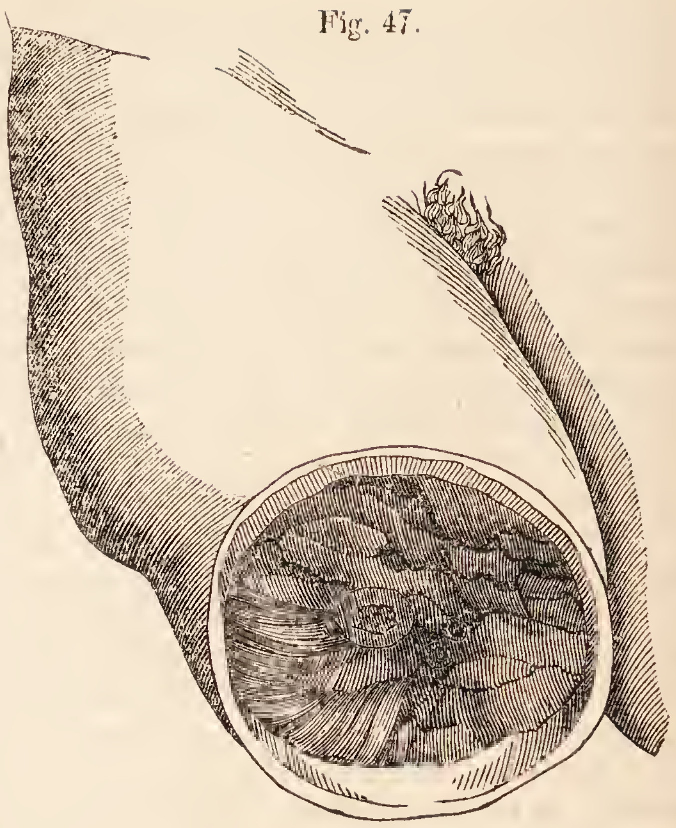


Fig. 47. *Circular amputation at the upper and thickest part of the thigh.*

Flap method.—In the general description of this method, already given in the first part of this article, will be found the details of its application to the thigh. It may be doubted whether the flap method for this particular amputation, really possesses any of the advantages ascribed to it. At the upper part of the limb, however, its superiority over the circular method is manifest from the greater facility it affords for confronting the surfaces of the wound. It is executed certainly with more rapidity, especially in young subjects, or when the limb is wasted; but those surgeons who disapprove of its application, except in cases of necessity, maintain that it is more painful, and that it involves a greater extent of the soft parts in the wound.

Fig. 48.

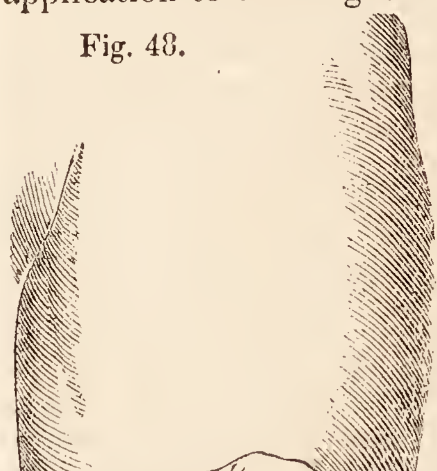


Fig. 48. *Amputation, by double flap, anterior and posterior, at the middle of the thigh. The shaft of the bone is bared to the extent of three or four inches, the length of the flaps. The operation is advanced to the point where the retractor is to be applied, and the bone sawed through.*

HIP-JOINT.

If the danger attending an amputation, be *cæteris paribus* in proportion to the volume of the parts through which the section is made, then is the amputation of the thigh at the hip-joint the most formidable that can be performed, buried as that joint is to a considerable depth, and surrounded on all sides by such a large mass of soft parts. These considerations very naturally deterred surgeons from attempting such an extensive mutilation, and it was only as the art made progress, and the principles on which success mainly depends became better understood, that the proposal for amputating at the hip-joint began to be entertained as a rational undertaking. Morand, it would appear, was the first who ventured to express an opinion on the possibility of its success; an opinion which was brought formally under the notice of the Academy of Surgery by two of his pupils, Wolher, a surgeon in the guards of the king of Denmark, and Paethod of Nyon in Switzerland, in the year 1739. The Academy in the following year received a favourable report on the Memoir of these surgeons, drawn up by Ledran and Guerin. Encouraged by the discussion, Ravaton was on the point of putting the proposed plan in execution, in a case of fracture of the great trochanter and neck of the femur from a gun-shot, and was only driven from his determination, by the adverse opinions of the surgeons with whom he consulted on the occasion. Lalowette made it the subject of a thesis, which was defended by Vallum in 1748. The subject seeming to several of the members of the Academy to be entitled to further investigation, it was made a prize question at the instance of Morand in 1756, and again in 1759. None of the essays on the first occasion were found worthy of the prize, which, on the second, was awarded to Barbet, who forcibly advocated the propriety of the operation, and pointed out the cases to which he considered it rationally applicable.

The question was propounded by the Academy in the following terms:—"*In the case in which amputation at the hip-joint should appear to be the only resource for saving the patient's life, to determine whether this operation ought to be practised, and what would be the best mode of performing it.*" Thirty-four essays were presented, including Barbet's, almost all of which, besides several other dissertations on the same subject, by Goursault, Moublet, and others, maintained the practicability of the operation, from experiments on the dead subject, or on dogs.

Notwithstanding the great encouragement thus held out, no one was bold enough to undertake the operation for a considerable time afterwards. True it is, however, that some cases had occurred in which gangrene having first made extensive ravages round the joint, the disarticulation of the thigh bone had been artificially effected; but this process, though it might be regarded as an encouragement, could not be taken in any sense as the equivalent of the amputation at the hip-joint, strictly so called.

Familiar as the discussions of the Academy must have made the minds of the French surgeons with the subject, it seems not a little curious that the first case in which it was performed is recorded of an English surgeon, Mr. H. Thomson, surgeon to the London Hospital. Pott was strongly opposed to the operation, and censures, in the following passage, its performance in the case which he had himself witnessed:—"That the amputation in the joint of the hip is not an impracticable operation (although it be a dreadful one) I very well know. I cannot say that I have ever done it, *but I have seen it done*, and am now very sure I shall never do it, unless it be on a dead body. The parallel which is drawn between this operation and that in the shoulder will not hold. In the latter, it sometimes happens, that the caries is confined to the head of the os humeri, and that the scapula is perfectly sound. In the case of a carious hip-joint this is never the fact; the acetabulum and parts about are always, more or less, in the same state, or at least in a distempered one, and so indeed most frequently are the parts within the pelvis." Mention of the second instance, in which it was put in execution in this country, occurs in the sixth volume of Duncan's Medical Commentaries, published in 1779. The operation was performed by Kerr, of Northampton, on a girl between eleven and twelve years of age. It would appear from Pott's censure on the first case, and from the description of Kerr's case, that in both these instances, the operation was resorted to for disease of the joint. The result in both cases was of course unfortunate, as the removal of the limb could have no effect in arresting the progress of the disease. In Kerr's case, the acetabulum and surrounding part of the os innominatum were carious, and there was extensive tuberculization of the lungs.

It was soon perceived that the analogy between amputating for scrofulous disease of the knee-joint in the continuity of the thigh, and disarticulating the head of the femur from a diseased acetabulum did not hold good. In most of the subsequent attempts, therefore, the operation was restricted to the cases in which Barbet had described it to be applicable, viz.: Where by sudden violence, as from gun-shot wounds, or crushing by machinery, a healthy bone is extensively injured at its head, neck, or upper part; where the limb is carried away by a cannon-shot close to the trunk; or where gangrene has so far extended, or threatens to extend, its ravages, as to render it impossible to obtain a sufficient covering for the stump by any other means. To these, as the principal cases in which this amputation is likely to be attended with a favourable result, may be added, lesions of the bone high up, from comminutive fracture, caries, necrosis, osteo-sarcoma, spina ventosa, or other incurable alterations beyond the reach of extirpation, by an amputation in the continuity of the femur.

When resorted to in this description of cases, some years later, it was successful. M. A. Blandin, a surgeon in the French republican army, in the third year of the Republic, operated successfully on a soldier. In a second case, he was equally fortunate ; and, in a third case, the patient survived the operation fifty-eight days. The operation was again successful in the hands of Perret, another military surgeon ; and, in 1798, Mulder performed it, with similar good fortune, on a girl of eighteen years of age. About the commencement of the present century, Larrey had already operated in two cases during the Egyptian campaign. Since that period it has been performed many times in different countries, and successfully too in a good many cases. Dr. Millingen is said to have operated successfully in two cases. Mr. Brownrigg was successful in the case of a soldier who was wounded at Merida, in 1812. This man was since, and perhaps is still, resident at Spalding in Lincolnshire. Mr. Guthrie successfully amputated the thigh at the hip-joint of a French prisoner, who is still living in the Hôpital des Invalides, at Paris. Delpech, Orthon, Mott of New York, Wedemeyer, Syme Brice, Sir A. Cooper, and lately Mr. Mayo, have each had a successful case. It would not be an easy matter to determine the proportion of the successful to the unsuccessful cases; but the reverses also are numerous. In 1812, Baffos, at the Hôpital des Enfans, lost a child seven years old, not in consequence of the operation, which, as was before observed, is not indicated in the scrofulous affection of the hip-joint, but from the progress of the disease. The little patient survived the operation three months : the acetabulum was diseased. Mr. Carmichael performed the operation in the year 1819, at the Richmond Hospital, Dublin, on a young woman of nineteen, for an osteo-sarcoma. The writer of this article, then a pupil of Mr. Carmichael's, was present. The operation was performed with great celerity ; the patient lived only till the fifth day. The operation, even in the cases in which it is indicated, has failed in the hands of some of the most eminent surgeons of the day, amongst others, Sir A. Cooper, Sir B. Brodie, Dupuytren, Mr. Guthrie, Baron Larrey, Blick, Cole, Delpech, Dieffenbach, Emery, Gensoul, Clot-Bey, Roux, and Pelikan of Wilna.

Various points have been indicated as guides to the articulation ; of which, in order not to embarrass the memory, we shall select only the most important. The great trochanter is easily felt ; it takes a direction upwards, inwards, is turned a little backwards, and forms a prominence about half an inch or a little more above the neck of the femur. The small trochanter projects about half an inch from the inside of the bone, at a nearly right angle from its axis, and is continuous with the lower part of the shaft, at an angle inclined upwards of 50° with the axis of the bone. If the patient be placed recumbent, the tuberosity of the ischium will be an inch and a quarter in advance of the acetabulum.

Again, if a perpendicular line be drawn from the anterior inferior spinous process of the ilium, the outer or anterior part of the joint will be about half an inch to the inside of the inferior extremity of this line. The articulation is most superficial in front, and corresponds with a line which would bisect Poupart's ligament, at the union of its outer with its two inner thirds.

The disposition of the capsular ligament deserves to be noticed : the head of the bone, which is nearly spherical, is not entirely sunk in the articular socket ; the capsular ligament, springing from the rim of the acetabulum, covers the outer portion of the bony sphere, and shrinks in ampleness, as the bone diminishes in size, to form its neck. If, therefore, the surgeon were to cut the capsular ligament low down on the neck of the bone, instead of dividing it round the edge of the acetabulum, the head of the bone being much larger than the opening made for its passage would remain locked in the cotyloid cavity. The internal or round ligament is easily thrown on the stretch, and even brought to the edge of the acetabulum by carrying the limb outwards. The same observation respecting the incomplete ossification of the epiphysis of the long bones may be repeated here. Up to the age of ten or twelve years, the great and small trochanter, and even the head of the femur itself are so soft that they may be easily cut with a knife, and the surgeon should be prepared to turn this circumstance to account on an occasion.

In front, the articulation is more superficial than at any other point, being here separated from the skin only by the psoas and iliacus muscles, by the rectus externally, and by the great vessels, but at some distance, internally. Behind, and on the inside, the muscular mass is very considerable. The depth of the articulation from the trochanter on the outside is considerable, but when the bone is removed there is little left to cover the acetabulum beyond the skin alone. Upon these points, therefore, must the formation of the flaps be regulated. As in the case of the disarticulation of the shoulder-joint, the amputation at the hip-joint is performed by all the various methods, or by processes combined from them, according to the necessities of the case, or the genius of the operator. We shall describe the principal modifications only.

AMPUTATION OF THE THIGH AT THE HIP-JOINT.

Flap method.—The operation is performed with a single or double flap. When two flaps are formed, they are cut in such a manner as to form an anterior and posterior, or two lateral flaps; the other modes of forming the flaps are but variations of these.

With two lateral flaps, or an outside and inside one.—In some of the early descriptions of this method, it is recommended, as a proper precaution against hæmorrhage, to tie the femoral artery, close up by Poupart's ligament, and above the origin of the circumflex and profunda. Larrey makes this the first step of the operation, (I, II, III, 1, 2, 3, figs. 42 and 43,) and the practice has the approval of Blandin, who thinks, that as the artery is easily secured, and the hæmorrhage from so large a vessel would be so quickly fatal, that it will be more proper, rational, and prudent, to begin the operation by placing a ligature upon it. Others, on the contrary, dissent from this doctrine, regarding it as an additional and a superfluous operation, and rely on the compression made on the trunk of the artery with a pad, or the fingers of an intelligent assistant, against the horizontal branch of the pubis. Cases, however, may occur, where the exhaustion of the patient is so great, that it becomes imperative to secure him against all mischances, and under such circumstances, it would be improper to slight this precaution.

But whether the artery be first tied or not, the patient is placed on his back, the pelvis supported by a pillow, and advanced to the edge of a bed or table. The surgeon places himself on the outside of the limb, and plunges a long slender knife into the upper part of the thigh, in a direction from front to back, so that the blade shall graze the bone just between the upper edge of the trochanter minor, and the root of the neck of the femur. The knife is urged on in the same direction until its point comes through the skin at the opposite surface of the limb; the edge of the knife is then directed downwards, and inwards, and keeping close to, but clear, of the small trochanter, and an internal flap about four inches long is made with a quick and even sweep of the knife. The flap is raised towards the opposite thigh, and the limb being carried a little in abduction, one-half of the capsular ligament is cut close upon the brim of the acetabulum, the edge of the knife being directed in the same manner as if the surgeon wished to cut off the spherical head of the bone through the middle. The movement of abduction is augmented, and the internal ligament being thus made tense against the head of the femur, is easily divided. The head of the bone being now drawn down, the knife is turned round it, and the other half of the capsular ligament is cut. The tendons of the gluteal muscles are cut through, close to the outer and back part of the great trochanter, and the knife is carried outwards and downwards, so as to form an external flap, similar to the internal one.

When the femoral artery is previously tied, the first flap incision should proceed from the inferior angle of the wound inflicted for that purpose; and, again, when the knife has doubled the head of the bone, it should be brought down the outside of it, until it falls again into the preliminary wound, and it is then carried outwards and downwards to form the external semicircular flap.

With an anterior and posterior flap.—Mr. Guthrie's method of forming the flaps differs from that just described in regard to the point from which the incisions proceed, and their direction. He first divides the integuments only, on the inside and then on the outside of the limb, from a point in front of the spinous process of the ilium, to another, close by the tuberosity of the ischium, where the two incisions join again (*o*, *p*, *q*, and *h*, *o*, *n*, figs. 42 and 43). The skin is reflected up, and the muscles are cut at the point of retraction, obliquely upwards towards the articulation. The two flaps thus formed are provided with an ample covering of integument, and may be described as internal and anterior, and external and posterior. Mr. Guthrie does not tie the femoral artery in the first instance as Larrey does, and his mode of operating differs only from that recommended by Beclard, in the incision and retraction of the integuments, and in cutting the muscles from without inwards, instead of plunging the knife in at each side of the head of the bone, and then cutting outwards. One obvious advantage obtained by proceeding according to Mr. Guthrie's plan is, that it leaves more integument and less muscle in the wound; and, in one of such extent, this is a consideration of no small importance.

Dupuytren used to form the internal flap by an incision, first, of the integuments, and then of the muscles upwards to the joint; he made the outer flap with one incision.

With a single flap.—This method is well described in one of the early theses on this subject by De Vallun:—The patient lying on the sound hip, the operator makes a transverse semicircular incision, from the upper part of the great trochanter to the tuberosity of the ischium, dividing at once all the parts down to the joint. (9, 10, fig. 42; 4, 5, 3, fig. 43). The limb is now rotated inwards, the outer and back part of the capsular ligament is cut, and the round ligament, with a probe-pointed bistouri. The limb is brought a little downwards, and the rest of the capsular ligament being cut, a flap four or five inches long, according to the volume of the limb, is formed from the flesh on the inside of the thigh. Manec, and Ashmead, of Philadelphia, have proposed reversing the steps of this proceeding, forming the inner-flap first, cutting from without inwards and upwards, then disarticulating the head of the bone, and cutting outwards.

When the femoral artery has been tied, previously to the formation of the flaps, the operation is terminated without stopping to secure the other bleeding vessels.

Lisfranc's plan; an external and internal flap.—This able operator, it is said, can complete the amputation in the hip-joint, on the dead subject, in ten seconds. He makes use of a long, thick, two-edged knife or catling. The limb being extended, and held, if possible, in a position between adduction and abduction. He recognizes, by drawing a perpendicular line, from the anterior superior spinous process, down the thigh, and another line, half an inch directly inwards towards the pubis, the spot on which he is to commence his incision. Placing the point of the knife on the end of the transverse line, he pushes it perpendicularly downwards, grazing the outside of the head of the bone, until it comes out a few lines lower than the tuberosity of the ischium. It is necessary, as soon as the point of the knife reaches the bone, to incline the handle upwards and outwards, in order to turn its point fair for the tuberosity; this manœuvre is facilitated by the surgeon or an assistant's taking hold of the flesh of the gluteal region, and carrying it, *en masse*, towards himself. As soon as the knife has passed completely through from front to back, the lower edge is inclined outwards and downwards, cutting about an inch in that direction, until it clears the great trochanter. This division is effected more with a sawing than a cutting motion; the knife then glides from the bone, obliquely, through the muscles, forming an external flap, four or five inches long.

Fig. 49.

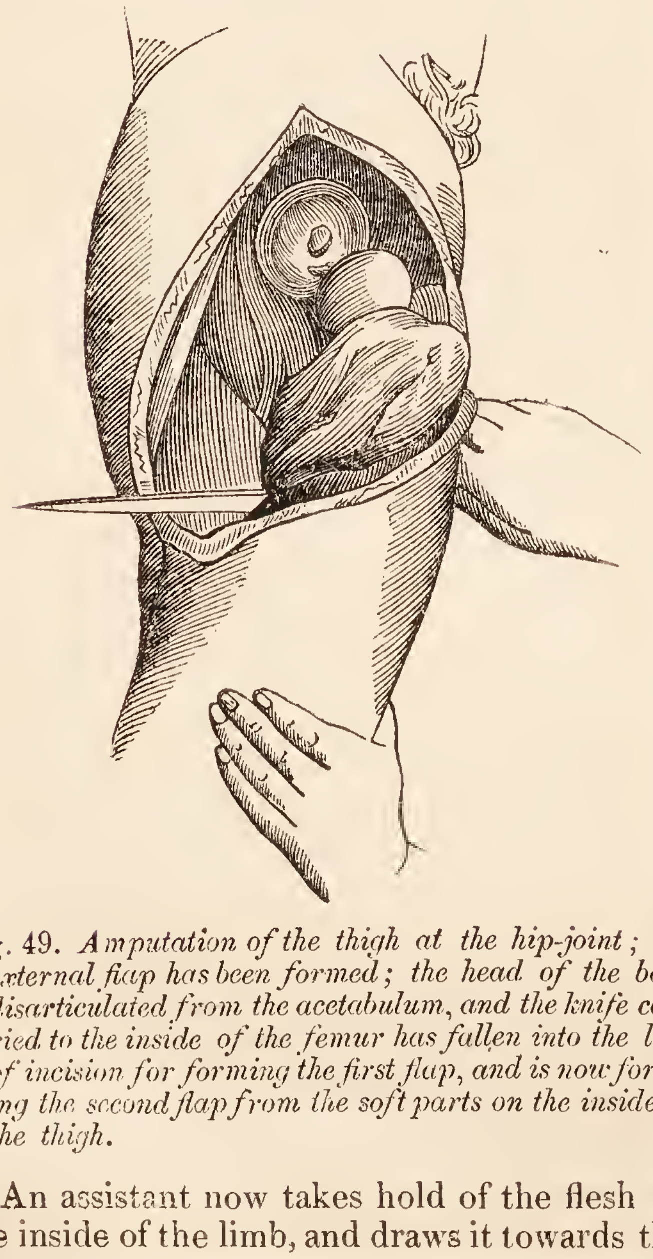


Fig. 49. *Amputation of the thigh at the hip-joint; the external flap has been formed; the head of the bone disarticulated from the acetabulum, and the knife carried to the inside of the femur has fallen into the line of incision for forming the first flap, and is now forming the second flap from the soft parts on the inside of the thigh.*

An assistant now takes hold of the flesh on the inside of the limb, and draws it towards the opposite thigh; and the surgeon placing the point of his knife again in the upper angle of the wound, inclines it slightly inwards, carrying the blade a little beneath, and to the inside of the head of the bone, so as to make it fall into the line of the first incision, and avoid wounding the integuments. He then cuts down the bone to the small trochanter, following this prominence with the edge of the knife; at this moment he directs one of the assistants to make compression on the femoral artery, by seizing the base of this second flap between his fingers and thumb; and he then terminates the internal incision, leaving the flap of the same length as the external one. The vessels are tied, and the head of the bone is disarticulated in the manner before described.

In Lisfranc's, and the other plans which resemble it, as to the formation of the internal flap, the facility of effectually compressing the artery in this flap, before the edge of the knife is turned outwards and downwards, is so great, that the preliminary operation of placing a ligature upon it may be safely dispensed with. As soon, however, as the internal flap is formed it may be tied. The flow of blood from the other vessels may be temporarily stopped by the fingers of assistants applied over them. Some surgeons, however, tie the arteries as the operation proceeds. Besides the femoral artery, the obturator artery, branches of the pudendal, ischiatic, and gluteal arteries will require torsion or ligature.

Circular method.—Mr. Abernethy, who advocated as far back as the beginning of the present century, the propriety of compressing the femoral artery against the horizontal branch of the pubis instead of placing a ligature upon it before the operation, was the first to propose, in his surgical lectures, the performing this amputation by circular incision. He used to make the first incision of the integuments a few inches below the articulation; the muscles were divided higher up, at the point to which the skin was retracted, and completely detached from the great and small trochanter. The capsular and the round ligament were then cut, and the limb removed. This method was adopted by Mr. Colles, in the case of the patient upon whom he operated, and by Krimer in his case.

Græfe also shows the same preference for the circular method in the amputation of the hip, which he gives generally to amputations in the contiguity. He performs the operation with his large knife, the blade of which is enlarged and rounded off at the end. He thinks this form of knife enables him in cutting the muscles, to hollow out the cone better. He divides the soft parts from without inwards, or rather from below upwards towards the joint. He avoids the difficulty which might be felt in disarticulating the head of the femur, by cutting the capsular ligament at the under part, where the brim of the acetabulum is imperfect. This difficulty is, however, easily obviated by observing the rule already given, of cutting the capsular ligament in the same manner as if the operator intended to leave half the head of the bone in the socket. Mr. S. Cooper mentions a case where, from neglecting this point, a very eminent surgeon was unable for half an hour to disarticulate the head of the bone from the acetabulum. Dr. Veitch is also in favour of the circular method. When the muscles are detached from the trochanters, he advises the detachment of the muscles for some little way down the limb, for the purpose of using the bone thus cleared as a lever to facilitate the separation of the head from its articular socket. This step is quite unnecessary, and causes delay.

The oval method proposed by Scoutetten, Cornuau, and Mr. Guthrie, though frequently executed on the dead body, has not as yet been resorted to in the case of a living person. It is thus described :—the patient lies on the sound hip, and the limb is supported in adduction by an assistant. The first incision is made from an inch above the great trochanter, and descends obliquely forwards to the anterior part of the thigh, to the extent of six or eight inches, if the patient be an adult. This incision terminates at a point at which a perpendicular line from the superior spinous process of the ilium, would cross another line drawn transversely from the tuberosity of the ischium, and divides the integument, and the muscles down to the bone. Another oblique incision of the same length is carried from above the head of the femur downwards and backwards to a little below the tuberosity of the ischium. The joint is thus freely exposed ; the capsule and the internal ligament are divided ; the head of the bone is luxated outwards ; the knife is carried to the inside of the neck of the bone. The assistant now compresses the femoral artery by inserting his thumb and fingers into the wound, and the operation is terminated by cutting downwards and inwards all the soft parts on the inside of the thigh, so as to unite the two extremities of the inverted V formed by the two first incisions.

Fig. 50.

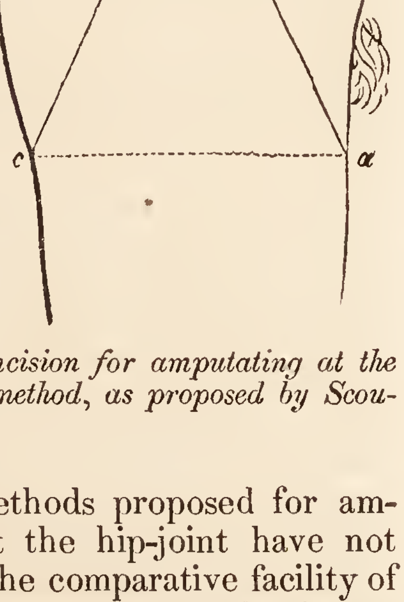


Fig. 50. *The lines of incision for amputating at the hip-joint by the oval method, as proposed by Scoutetten and Cornuau.*

The numerous methods proposed for amputating the thigh at the hip-joint have not originated solely in the comparative facility of performance : the very nature of the injury may create a necessity for proceeding in a given way, and exclude the exercise of choice or preference ; and hence it is, that though one mode of proceeding may, in a general sense, be more advantageous than another, they must all be retained as resources for special cases.

The majority of the amputations hitherto performed at the hip-joint have been executed according to the flap method, or some of its modifications. This preference seems to have been accorded, both on account of the great bulk of the limb itself, and the anatomical configuration of the articulation. If the flap method is preferred in amputating the thigh high up near the trochanters, how much stronger must be the reasons for the preference, when the operation is to be performed in the articulation itself! But in the flap method as applied to this operation, there are certain modifications more or less favourable. The flaps which contain most skin and least muscle are the best ; as the liability to inflammation and extensive suppuration will be least in flaps so formed. This is one excellence of the mode of proceeding recommended by Mr. Guthrie and Dupuytren. The anterior and posterior flaps, when the state of the soft parts will allow of their being made of equal length, are most readily adjusted ; and when the parts are extensively injured, as the integuments are divided by a separate incision, an adequate quantity of them may be preserved with very little of the muscles. The oblique position of the flaps would also give greater facility for filling up the deficiency occasioned by the removal of the head and neck of the thigh bone.

The same advantages do not attach to the method when performed on the plan of Larrey, Lisfranc, &c. The external flap cannot be made sufficiently full, and ample to correspond with the internal one, and most commonly it will be either so irregular or deficient at its posterior part as to require points of suture to maintain it in coaptation.

When the accident has spared only enough of the soft parts to form a single flap, there is no room for choice ; it must be formed as best it may. If the parts on the anterior and internal region of the thigh are sufficient, the plan of Manec and Ashmead will afford the best result ; the section being made from without inwards, and the skin being divided first, a flap ample of skin and scant of muscle is thus procured. Velpeau, in a case in which he adopted this plan, describes the flap as covering the wound without effort, and remaining properly applied as it were, by its own weight.

The oval method is of very easy execution, if we may be allowed to judge from what we observe on the dead subject ; but the covering it leaves at the upper part of the wound, where the excavation of joint is to be filled up is rather scanty. This inconvenience might be obviated by making the incisions somewhat after the manner Larrey amputates the shoulder-joint.

The circular method is the most difficult of execution, and the least advantageous of all, for amputation of the thigh in the articulation.

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(*T. King.*)
(*W. B. Costello*[1].)

AMYLUM, Lat.; ἄμυλον, (from α priv., and μύλη, *a mill*, being prepared without grinding), Gr.; *Stärke*, *Satzmehl*, Ger.; *amidon*, Fr.; *starch*, Eng. A name given to the fecula obtained from the cereal grains, and from the bulbs, stalks, and roots of various plants. The use made of starch in surgery is very limited. Powdered starch is sometimes employed as an external application in erysipelas, and in the cutaneous erubescence of new-born infants; in a liquid jelly it serves as a vehicle for the injection of anodynes into the rectum. As a poultice it is now but very rarely used.

ANABROCHISMUS, ἀναβροχισμὸς, (from ἀνὰ, "with," βρόχος, "a running knot".) An operation of the ancient surgeons for preventing the eye-lashes from turning upon, and irritating the eye, effected by knotting a hair around them. It is mentioned by Hippocrates, Galen, and Celsus. It is now obsolete.

ANAPLASIS, obsolete, ἀνάπλασις, Gr. *confirmatio*, Lat. Hippocrates used this term to designate the union or consolidation of a fractured bone.

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[1] The Editor having had the misfortune to be deprived, by illness, of the able assistance of Dr. King, who had originally undertaken to write the article Amputation, was compelled to take up the subject where it was thus interrupted. With the exception of the section entitled *Measures necessary to arrest hæmorrhage after amputation*, the Editor's part of this article embraces from page 142, commencing with the history and description of the Flap Amputation, to the end. He acknowledges with pleasure the great obligations he has been laid under by his friend Mr. Pilcher, who kindly placed at his disposal, for sketching and verifying the wood-cuts which illustrate this article, all the subjects employed during the course of surgical operations delivered by Mr. P. during the present session at the Webb-street School.

ANAPLEROSIS, obsolete, *ἀναπλήρωσις*, "filling up." That part of surgical therapeutics whose object is to supply, by artificial means, parts that are wanting. (See Prothesis.)

ANASARCA, Lat., *ἀνάσαρκα*, Gr., from *ἀνὰ*, through, and *σὰρξ*, the flesh; *Leibwasser, Hautwassersucht*, Ger.; *anasarque*, Fr.; *dropsy of the cellular membrane*, Eng. The term implies a general serous infiltration of the cellular tissue, but more especially the portion of it interposed between the skin and the muscles; when the infiltration is not general, but circumscribed within a particular region, it is known by the name of œdema.

Anasarca, like the other forms of serous effusion, may be either symptomatic or idiopathic; it may be active or passive. Considered without reference to the causes from which it may arise, the infiltrated condition of the cellular tissue, known under the term anasarca, results from the condensation of the animal vapour which is constantly exhaled from all parts of the cellular tissue, whether that condensation is produced by an excess of the secretion itself, or the absence of absorption.

As our notice of this affection is confined to the mere point of view in which it is susceptible of relief or cure from surgical means, it will not be necessary to enter into a full disquisition of its causes, varieties, complications, &c. We shall, therefore, only state in general terms, that it may depend upon excitement or irritation in the cellular tissue itself, or its vessels; on inflammation, or obstruction of the veins, or simply from any mechanical impediment (as for instance, a tumour,) to the free return of the blood; and on various organic alterations in the important organs of the economy, as of the heart, or its large blood-vessels, pericardium, lungs, kidneys, &c.

The causes of anasarca may very naturally be arranged into two classes: in one the symptoms are acute; in the other they are chronic, and symptomatic of some primary affection. In the early stages of life, great activity of function prevails in the cellular tissue, erythematous inflammations are more frequent, and hence the greater frequency of the active forms of anasarca at this period of existence. Youth, vigour, and the sanguineous temperament, therefore, are justly regarded as predisposing, while a too generous alimentation, the suppression of hæmorrhage, either natural or accidental; the sudden stoppage of perspiration; or the impression of cold, especially after eruptive diseases, may be enumerated amongst its occasional causes. It has also been observed to come on suddenly, after violent emotions of the mind, or the disappearance of the symptoms of gout, &c.

The characters of the passive or chronic anasarca are very different: here the phenomena are of the asthenic kind, and are dependent either on morbid affections of the heart, large vessels, lymphatics, of some of the principal viscera, in a word; or on direct debilitation, resulting from insufficient food or clothing, insalubrious habitation, frequent and considerable loss of blood, &c.

The symptoms of this affection, derived as they may be from pathological conditions so essentially different, are serious, or otherwise, in regard to the evanescent excitement or permanent lesion from which they take their origin; and they present a degree of variety dependent on the causes from which they arise.

The sthenic, or acute anasarca that occurs during convalescence from scarlatina, is characterized by the suddenness of its appearance and the rapidity with which it spreads. A great part, sometimes even the whole body, is swollen, although the colour of the skin is scarcely changed, or if it should be, it presents a very slight rosy hue; it is elastic and sensible to the touch; it also seems polished, and hotter than usual. When pressed upon, it does not retain the mark of the fingers, and it sometimes presents, at various points, an erysipelatous blush. These symptoms coincide with others of a constitutional kind. The pulse becomes hard and frequent; the countenance flushed, the eyes brilliant, and the tongue parched. There is great thirst, but no appetite; and sometimes there is severe headache, sickness, and intolerance of noise or light. The urine is scanty and high-coloured. The patient complains of pains in the loins, or in the articulation; he is listless, yet uneasy. Sometimes the severity of the symptoms is still greater: the abdomen is painful to the touch, there are colicky pains, with diarrhœa; excessive difficulty of breathing, with irregular and quickened pulse, and extreme restlessness.

The inflammatory, or active anasarca often occurs, however, without such well-marked symptoms of general reaction. Its progress may be extremely slow. The swelling begins in the feet, and ascends the legs, thighs, scrotum, &c. The colour of the skin remains unchanged, and the augmentation of heat or sensibility is scarcely perceptible. The excitement of the cellular tissue, though obscure, is still the cause of the phenomenon. The infiltration is not of the passive kind.

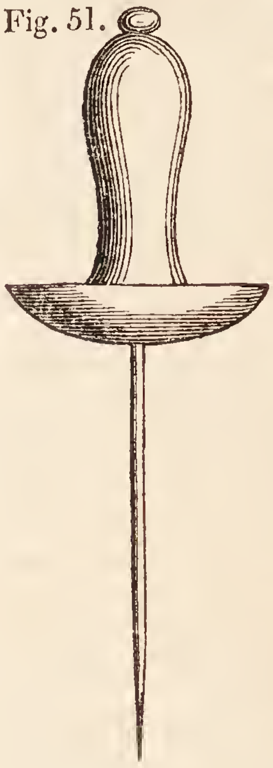
When the anasarca is of the asthenic kind, or symptomatic of some serious lesion, the character and march of the symptoms are different. Before any appearance of infiltration is shown elsewhere, the face is puffed up, and paler than usual, or the ankles are swollen, and present a doughy feel to the touch. The intumescence from this point proceeds at first very slowly. The skin feels cold, and its temperature is in reality reduced; its colour is a dull white or yellow, becoming more and more glossy as the distension increases; its elasticity or resistance diminishes, and it retains, for a considerable time, the pits or seams made upon it by the pressure of the fingers or the clothes. The quantity of the effused fluid becoming more and more considerable, it becomes obedient to the laws of gravitation, and accumulates in those parts which are most depending; but as these become overcharged, it ascends and distends the higher regions.

At first the accumulation seems greatest in the evening, particularly if the patient has been much in the erect position during the day; but after the repose of the night, it seems to disperse so that scarcely a trace of it is to be observed next morning. The quantity increases progressively, until the infiltration is found to be general in the legs, thighs, scrotum, hips, loins, abdomen, chest, neck, face, eyes,—in a word, over all the surface of the body, with the exception of the palms of the hands and soles of the feet. Nor is the effusion confined to the cutaneous cellular tissue; it penetrates also into the intermuscular layers, and along the tracks of the great vessels. The muscular contractility is enfeebled under the great weight of the accumulation, and the patient moves with difficulty; the surface is cold, and its sensibility is often blunted to such a degree that the skin may be cut, or even burned, without the patient's being in the least aware of it. There is great thirst, and the urine is highly coloured, scanty, and sedimentous. When the distension of the skin becomes extreme, it is separated by a considerable distance from the sources by which it is nourished; the capillaries are attenuated, and convey but little blood; and on this account there is a great tendency in the skin to inflame and slough, at various points, and from very trifling lesions.

The pathological condition of the cellular tissue varies according to the cause in which the infiltration has originated, or the length of time the effused fluid has remained, as it were, stagnant in its areoles. When the cause is of the active or sthenic kind, and limited to the cellular element itself, this tissue will be found reddened, injected, and indurated at some points. When, on the other hand, the anasarca is a mere symptom of serious organic lesions, the cellular tissue is a mere recipient; it is inundated with fluid, at first without any sensible alteration of its structure. When this state of things continues, it suffers from maceration, it becomes discoloured, as do also the muscles; their powers of resistance are impaired, and they are torn with the greatest facility. It will be often in the power of the surgeon to prevent this complication by well-timed interference; but in general, the root itself of the evil is much more serious, and is only susceptible of palliation.

Treatment.—The remedies to be had recourse to differ according to the causes and conditions in which the affection has had its origin. When it depends on simple excitement of, and is confined to, the cellular tissue, the antiphlogistic treatment is indicated. Local will be better than general bleeding, except in cases where the disease has been produced by plethora; leeches in sufficient number may be applied to the margin of the anus, or the vulva, when it can be traced to suppression of habitual evacuations by hæmorrhoids, or the catamenia. Some surgeons prefer general bleeding in small quantities, and frequently repeated; and it is certain that the anasarcous swelling is often dissipated very rapidly under this plan of treatment. Saline and diaphoretic medicines are exhibited internally, with nitrated diluents; and punctures may be made, without fear of bad consequences, when the effusion is considerable, in order to give issue to the fluid, and diminish the tension of the skin. The point of a lancet is used for this purpose. An acupuncture needle will be found to answer better. Sir B. Brodie uses a particular kind of needle for evacuating the serum. See fig. 51.

Fig. 51.



The passive form of anasarca, whether it arise from morbid alterations of important organs, or from general debility, unaccompanied by such alterations, is in every point of view a more serious malady. Of course, the chances are more favourable for the patient, when the affection is nothing more than the indication of a general atonic condition. Here we must do the very reverse of what is recommended in the active form of the disease; we must encourage, instead of repressing the movement of reaction. The patient's recovery will reward our perseverance in the employment of proper hygienic and therapeutic means. But when the disease is merely the symptom of some serious lesion of the viscera, or of the great blood-vessels, cure is but too often beyond the reach of art. It is true, the surgeon will succeed in dispersing an anasarcous effusion, dependent on the existence of a tumour, or the development of an aneurismal sac, by extirpating the one, or placing a ligature on the other; but these are inapplicable and insufficient in a vast number of other lesions of the vessels and viscera, and in which the surgeon can do no more than palliate the distress which may arise from the excessive distension which the anasarcous effusion produces.

The punctures recommended to relieve the over-distended skin in the anasarca from cellular inflammation, though capable of effecting the same object, viz. the evacuation of a considerable quantity of the fluid, is by no means so secure against bad consequences, and should be employed with great reserve. In some cases of a very urgent nature it will be proper to have recourse to them. It will be better to relieve the skin from the excessive distension, than to allow it to crack extensively, or to become stripped over the parts on which the patient lies. When the patient's strength is much reduced, the skin is considerably distended, and the distress of breathing is very great; under such circumstances, punctures ought to be made to give issue to the fluid, without regard to the local inflammation and sloughing which may arise in consequence.

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(*Wm. B. Costello.*)

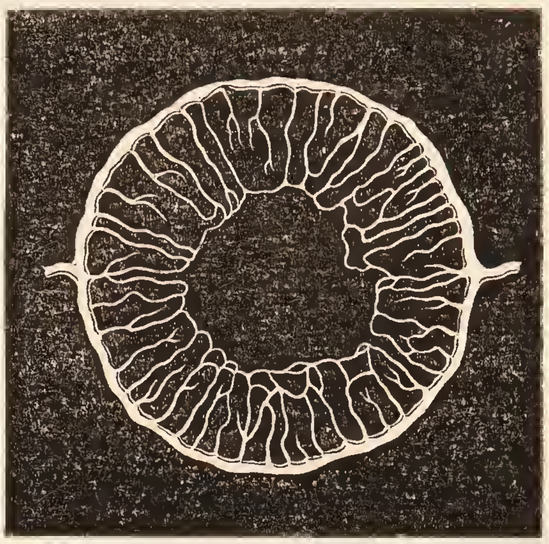
ANASTOMOSIS, (from ἀνὰ, through, and στόμα, a mouth,) ἀναστόμωσις, Gr.; *Verbindung*, Ger.; *anastomose, abouchement*, Fr.; *inosculation*, Eng. Anastomosis, in an anatomical sense, means the communication that obtains between different parts of any system of vessels, nerves, &c., and is found in each of the ramifying systems,—in the arteries, in the veins, in the lymphatics, and in the nerves.

The anastomoses of the *arterial system* which are to be here considered, serve three distinct purposes; they prevent a defective supply of blood; they diminish the velocity in the current of the blood; and they diminish the weight of the column of blood.

To fulfil these different offices, there are different modes by which arteries anastomose. Two trunks of equal diameter may unite to form a single trunk, as, for instance, the two vertebrals, to form the basilar artery; or two trunks may communicate at a particular part by a transverse branch, such as the two anterior cerebral arteries, by the arteria transversalis: or two trunks may join and form an arch, as in the instances of the mesenteric arteries, and coronary arteries of the heart; in those of the stomach, lips, eyelids, and iris; and in the palmar arch.

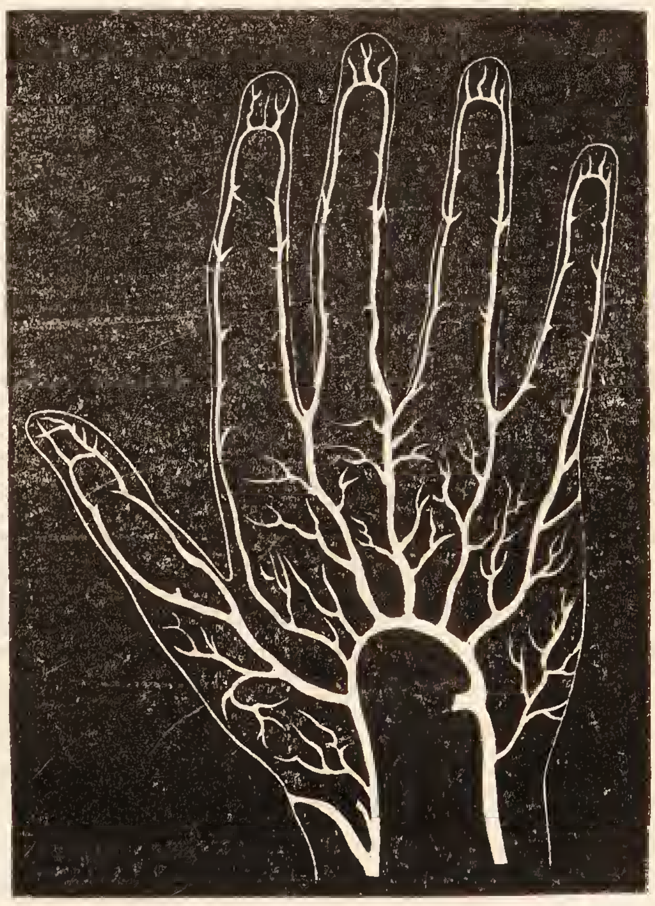
In consequence of these and other inosculations, the due supply of blood to different organs can never be interrupted, though its flow in particular vessels may be obstructed by a variety of causes, particularly by alterations of posture, and by muscular contractions; and hence it is justly remarked, that the arterial system ought not to be compared to a tree, the branches of which are isolated; but to a tree, all the branches of which communicate with one another.

Fig. 52.



The anastomoses of the arteries of the iris, represented in fig. 52, show how that organ is supplied with a constant stream of blood during its unceasing movements. The vessel which is seen passing around the circumference of the iris receives its blood from two channels, so that the circulation can never be interrupted. From this trunk the different branches come off at right angles to supply the iris, pass forwards to the pupillar opening, where they inosculate with each other, forming a sort of festoon, in such manner that the circulation of the blood shall go on uninterruptedly, whether the pupil be in a state of contraction or dilatation.

Fig. 53.



The anastomosis of the palmar arteries represented in fig. 53, shows how all the parts of the hand and fingers continue to be supplied with an uniform quantity of blood while grasping bodies, as well as during all their varied positions.

There is a form of anastomosis,—a *rete mirabile*, in the arteries of particular organs in different tribes of animals, which is intended in some cases to secure an equal supply of blood, in others to prevent an undue supply to the organ, when from the particular habits of the animal, the circulation of the blood is liable to interruption. The *rete mirabile* of Galen, which is met with in Graminivorous Animals, affords a beautiful example of a provision in the mode of the distribution of arteries in the head to prevent any increase in the weight of the column of blood, when the animal is grazing, an effect which would be necessarily produced, did not the internal carotid arteries in that tribe of animals divide, become tortuous, again unite, and in that manner ward off all undue pressure from the increase of the weight of the column of blood which, were these vessels rectilineal, would be caused on the brain, when the head is inclined downwards. In Aquatic Birds, which are in the habit of diving in search of their food, the *rete mirabile* of Hovius affords another example of an artery subdividing and then reuniting for a similar purpose as the *rete mirabile* in the graminivorous animals. As a perfect state of the organs of vision must be more especially requisite in diving birds, when their body is placed perpendicular in gathering their food under water, the subdivision and reunion of the ophthalmic artery or the *rete mirabile* must prevent any injurious effects which would otherwise be caused by the increased weight of the column of blood in the eye, were the ophthalmic artery rectilineal.

Retia mirabilia are also employed in the Cetaceous Fishes to prevent an undue accumulation of arterial blood in the large vessels, and central organ of the circulation, when these animals are deep under water. John Hunter, in his account of the anatomy of the whale, describes a most extraordinary extent of *rete* particularly in the intercostal arteries of these animals; and the same beautiful structure may be seen in the porpoise. When the bodies of the *cetaceæ* are subjected to the enormous pressure to which they are constantly exposed from the immense depth of the waters in which they dwell, the circulation of the blood in the exterior of the body must be interrupted, and hence the blood will be driven into and congested within the thoracic cavity. To prevent any over-distension of the vital organs contained within the chest, the *rete mirabile* formed by the intercostal vessels, acting like a reservoir, will receive the surplus blood, and detain it until the animal rises from the deep, and approaches towards the surface of the water, which, by taking off the pressure of the superincumbent medium allows the circulation of the exterior part of the body to be renewed.

While these forms of anastomosis are had recourse to, in the examples which I have given, in order to prevent an undue quantity of blood being sent to particular organs, I have also mentioned that a similar form of structure is found to be employed for the purpose of securing a proper quantity of blood to a part which, from the habits of some animals, would be otherwise occasionally deprived of its requisite quantity of the sanguineous fluid. The most remarkable illustration of this provision is met with in the limbs of the Sloth, the arteries both of the legs and arms of these animals being formed into a *rete*,—to which, however, Sir Anthony Carlisle, who first described this structure, seems to me to have given a very erroneous and unphilosophical explanation, attributing to this mode of distribution in the arteries, the remarkably slow movements of this tribe of animals. The singular and no less curious part of the natural history of the sloth, is not, however, its extremely sluggish motions, which Sir A. Carlisle conceived could be explained from the peculiarity in the distribution of the brachial and femoral arteries, but the great muscularity which it possesses in grasping, or of suspending its own body for a most extraordinary length of time. "We are told of a sloth that, having fastened itself by its feet to a pole, remained in the situation during fifteen days, and without sustenance! The strength in the legs and feet is so great, that having seized anything, it is almost impossible to oblige this animal to quit its hold. The same sloth grasped a dog that had been let loose upon it, and held it until it perished with hunger[1]!"

The multiplied subdivisions of the brachial and femoral arteries of the sloth, and the subsequent reunion of these vessels into one trunk, must, therefore, be considered as a peculiarity of structure connected with the extraordinary power which these animals possess of clinging to branches of trees for a very prolonged time, and which they are impelled to do, in order to gather their food. Did the artery in the limb consist of one trunk, and was it in the usual situation, it is evident that the circulation would be disturbed, if not altogether interrupted, when the animal grasped with its limbs for any lengthened period; but all such compression is completely averted by the subdivisions of the brachial artery being so numerous at the part of the limb where the pressure is made, that whenever any of the vessels are compressed, and the circulation through them impeded, the blood finds a ready channel in the other branches of the trunk. There is even a further provision to ward off the effects of pressure on the brachial arteries of this animal, and which is so well known in the *feline* tribe,—the artery passing through a foramen on the inner condyle of the humerus; which may, indeed, be considered as an additional proof of the office which is required of the arterial plexus of the artery in the limbs.

The anastomosis of arteries have considerable influence in modifying the *velocity* of the current of the blood in the inosculating branches. This must take place in a remarkable manner in the basilar artery, where the two opposite currents in the vertebral and carotids meet one another; and also in the coronary arteries of the different organs as well as in the inosculations of the mesenteric vessels, and, indeed, of the innumerable arte-

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[1] Bewick's Natural History.

rial capillaries in every organ, and in every part of the body.

Besides the important offices which anastomosis performs in securing to every part of the system a necessary supply of arterial blood as well as of modifying the velocity of the current of blood in different organs, the inosculations of arteries execute a no less important function, when, either from disease or accident, the flow of blood through an arterial trunk has become interrupted. To such extent, indeed, is this office of the anastomosing vessels sometimes demanded, that not only have large arteries been obstructed while the blood continued to be supplied in sufficient quantity to the parts on which they were ramified, but trunks of the first order in magnitude, and even the aorta itself, have been obliterated, and the circulation has been carried on by the anastomosing vessels.

The mode by which this important office of the anastomosing vessels is performed is a subject of interesting investigation. When the obstruction of an artery is caused by disease, as a diminution of the calibre of the vessel must almost in every case take place very slowly, the enlargement of the inosculating vessels must also progressively correspond; but where a ligature is placed on an artery, or the flow of blood through it, is by any cause suddenly interrupted, the changes in the inosculating branches, or in those vessels which are to supply the part with the blood to which the obstructed artery was distributed, must be immediate. These changes have been observed by examining limbs in which the principal arterial trunk had been obstructed, and the parts examined at different periods after a ligature had been placed on an arterial trunk, more particularly in cases wherever such an operation had been performed for the cure of aneurism. Some changes in the inosculating vessels may also be observed during life, when the inosculating branches are superficial, as the branch of the external carotid; or, still more distinctly, when they are also situated in a transparent part such as the conjunctiva or the cornea.

No sooner is the circulation through an artery obstructed, than an immediate change takes place in the anastomosing vessels. I had an opportunity of observing these changes in the branches of the external carotid artery, after a ligature was placed on the trunk of the common carotid artery of the opposite side, in the instance of a very young and emaciated subject, so that the vessels could be distinctly seen through the thin and delicate skin which covered them. No sooner was the flow of blood through the common trunk of the carotid artery impeded, than the branches of the external carotid of the opposite side of the head, more particularly the temporal and occipital vessels, became manifestly enlarged and tortuous, exactly in the same manner as when an injection is forcibly thrown into the arteries of the dead body, whilst, at the same time their action became very much increased.

It is by no means unfrequent, when a part of the cornea has become dim, or a speck has been formed in consequence of previous inflammation, that one or more vessels conveying red blood pass across the transparent part of the cornea and terminate in the speck. However dubious the benefit from such a practice may generally be, yet the vessels in such cases have frequently been divided, in order to prevent the speck being nourished, and thus to aid the action of local stimulants in promoting the absorption of the opaque matter. When only one red vessel can be discriminated passing into a speck, and if it be not only divided, but a portion of it also removed, and the eye examined, even a few hours afterwards, besides more or less redness, both of the corneal and sclerotic conjunctiva, occasioned by the excitement of the operation, the divided vessel appears regenerated, and a trunk is observed of the same size, and precisely in the same situation, uniting with, or in continuation of that portion of the canal which had been not only divided, but altogether removed.

The changes which have been met with in the dissection of limbs, the arterial trunks of which had been obliterated for the cure of aneurism, satisfactorily explain not only the ultimate changes of the inosculating vessels which are employed to carry on the circulation, but enable us satisfactorily to account for the immediate effects which take place on the inosculating branches, when the circulation through an arterial trunk is suddenly obstructed; they also explain the cause of that singular appearance, the almost immediate regeneration of an artery, observed when a portion of a vessel passing into a speck of the cornea has been removed.

From the dissections of limbs which have been operated upon for aneurism, at a very long period after the operation had been performed, a trunk almost as large as the femoral artery itself has been found so near the site of the original trunk that it must have been mistaken for it, had not the thickened and collapsed cord into which the obstructed vessel was converted been discovered. In a patient, whose limb was amputated many years after the femoral artery had been obliterated, for the cure of a popliteal aneurism, there was a trunk observed on the surface of the stump, similar in size, and apparently situated so precisely in the place of the femoral artery, that the operator was puzzled to account for the appearance, but the circumstance was readily explained by finding, on the examination of the amputated limb, the remains of the original vessel converted into a substance resembling the umbilical cord, whilst the limb was chiefly supplied with blood by a large trunk which ran parallel, and in close contact with the obliterated vessel, (A. Cooper). This interesting fact will, therefore, account for the hitherto inexplicable circumstance which has been mentioned, of the almost immediate appearance of a red vessel on the cornea even after a portion of one has been removed: the new vessel, under such circumstances, not being a reunion of the divided mouths, or a regeneration of the portion of the canal which was cut away, but the enlargement of an adjacent inosculating branch.

It ought to be observed, that however rapidly such a change may take place, when such small vessels as those of the cornea are divided, or a portion of them removed, a much longer period is necessary for one inosculating vessel adjacent to the obliterated trunk to undergo such an increase of its calibre, and attain such a size as to be the chief means of carrying on the circulation. When the circulation is suddenly cut off in the main trunk, all the anastomosing branches bear a part in carrying blood to the organs or parts thus deprived of their supply. The contributions of all are required in the first instance. This service is, however, but temporary. After the lapse of some time, one or more of these vessels becomes permanently enlarged, through which the circulation is continued, while the inordinate function of the others being now no longer necessary, they shrink to their primitive size. We may, therefore, conclude from the phenomena which are observed to take place in the branches of the external carotid artery, when a ligature has been placed upon the common trunk of the carotid at the opposite side of the neck, that there is not only an immediate change in the inosculating vessels, but that they at first all participate, every one being employed to supply to the member its defective quantity of blood, whilst it is only after the lapse of many months that one of the inosculating vessels performs, almost entirely, the office for which numerous branches were at first employed.

(*James Wardrop*).

ANATOMY, MORBID. Morbid anatomy, or pathological anatomy, comprises that division of the science of anatomy which treats of deviations from the normal or healthy state which the bodies of animals in general, and of man in particular, may exhibit as a whole, or in any of their parts or organs, as the result either of original malformation, or of disease or accident.

Although it is obvious that so comprehensive a subject must furnish abundant materials for separate and distinct consideration, yet it may very naturally be supposed that most, if not all these objects are so closely connected with those of the general and special anatomist, as well as with those to be treated of under the heads of surgery and medicine, that a distinct article must involve needless repetition. An author who is engaged with the description of the features and treatment of a medical or surgical disease, must unquestionably find himself compelled to treat of the morbid anatomy of that particular subject. It is not, therefore, the object of the present article to interfere with, or supersede those pathological descriptions, which must be scattered through, and inseparably interwoven with the individual articles in the Cyclopædia of Surgery. The distinct consideration of the subjects presented by pathological anatomy, as a whole, will not only render those scattered descriptions more intelligible, and consequently more easily retained in the memory; but it may be regarded as essential to the setting forth of the analogy or similarity between the derangements of different parts and textures of the body.

It will also show that in the disturbed operations of organic life, which give rise to the almost innumerable irregularities which present themselves to our view, there is, nevertheless, an order and regularity in these very aberrations, and that they lose much of their apparent intricacy when we obtain the clue or key.

The deviations from the healthy or normal condition of the human body, or its parts, although admitting of almost endless varieties, may, notwithstanding, be arranged in two distinct groups,—the one comprising those deviations which consist of perversion in size, proportion, form, number, or situation, interruptions of continuity, and in short, whatever change simply requires the accurate knowledge of the minute special anatomist for its detection. The other group of deviations comprehends whatever changes may be brought about in the intimate tissues or structures of which the various parts of the body are composed. It comprehends a class of phenomena which require for their perception and appreciation a thorough acquaintance with the too much neglected department of general anatomy. Although we have here two essentially distinct modes of deviation, yet we shall necessarily find in practice that these modes are continually blended together in the same cases. The organ which has become so enlarged as to attract attention by its dimensions, and occasion the displacement of other organs, which the descriptive anatomist will minutely detail, will almost invariably be found to present, throughout the whole or a part of its increased bulk, some more or less striking deviation from the healthy arrangement of its particles, which cannot fail to suggest a query as to the nature of the change of composition which has taken place. The general anatomist, to whose department this question would seem to belong, may recognise a structure with which he was acquainted, but which special anatomy will inform him does not naturally belong to the part of the body in which it may have been found, or, at least, to the extent in which it has occurred. Thus, he may find that the mass on which he is called to pronounce an opinion, consists of bony matter, which does not, in the healthy state, exist in the part of the body in which it has been discovered; or it may be a mass of fat, which, though it may present very much the character of healthy adipose substance, is irregular or morbid as furnished by a part in which it ought not to have existed. But the general anatomist will not always recognise a structure with which he is acquainted; and special anatomy may inform him that the substance under examination has been found in the situation of this or that organ which could not be discovered in its healthy state, and consequently there may be reason to believe that the body under examination in some way or other owed its origin to the organ of which it has taken the place. Furnished with this information, the inquirer will proceed to examine the peculiarity of this strange texture; and he may discover, or conceive that he discovers in it, some traces of the natural structure which should have existed in that situation, or, on the other hand, the substance under examination may present so foreign an appearance as to lead to the conclusion that some entirely new growth has taken the place of the original structure. The general anatomist, as well as the special anatomist, will therefore find that he is engaged in an inquiry beyond the limits of his department, though closely bordering upon it. It belongs to morbid anatomy to solve the question, or to pursue the inquiry, if that which is already known be imperfect.

The cases which have been just supposed will serve to illustrate three subdivisions which morbid anatomists have employed, and respecting which there has been great disagreement and controversy. Where the body whose irregular presence has attracted attention is found to consist of bone or fat, or some other structure which the general anatomist recognises as natural to the body, the morbid appearance is said to consist of *the accidental production of a natural or analogous tissue.* When the natural structure no longer exists, although some trace of the structure belonging to the part may still be discoverable, the morbid appearance is said to depend on *the degeneration of the natural structure;* but when the pre-existing natural structure has given way to the encroachments of an entirely new production, it is said that the morbid appearance is the result of the *accidental formation of a new, distinct, or heterologue tissue.* This distinction, which appears plain, simple, and natural, and strictly inherent in the nature of the subject, would probably command universal assent were it not for the difficulty of deciding, in various cases, as to the group under which the morbid structure should be placed. The distinction between the degenerations and adventitious productions of the heterologue kind has produced a schism, in opinion at least, between some of the most acute and able pathologists, and each sect has had its zealous partizans. A minute knowledge of the intimate structure of the diseased part, and of the steps in the process by which it has been produced, can alone settle these disputed points. In the meantime the morbid anatomist, whilst he may adopt or reject the views of one particular sect, should be no less acquainted with those adopted by his brethren who may dissent from it; and it is especially expedient that he should not only have a clear perception of the various forms of diseased texture, and of their distinctive differences, but that, in speaking or writing respecting them, he should adopt terms and expressions sufficiently explicit, that others may not be at a loss respecting the particular form or mode of derangement to which allusion is made. Errors and defects in this respect are by no means unfrequent in writings and discourses concerning the objects of morbid anatomy, and they are the more to be regretted because they not only occasion misunderstanding between the parties immediately concerned, but tend materially to retard the progress of this department of science, by incumbering it with adventitious difficulties This evil does not wholly, or even principally, depend upon the nomenclature of the science, which I shall have to notice hereafter. It is perhaps yet more to be attributed to the want of precise ideas to be conveyed by the terms employed. The increased accuracy and precision which have of late years been adopted by pathological writers, the multiplication of museums rich in pathological preparations, and the increased fidelity of pictorial representations which have been numerously published and widely circulated, will do much to remedy the evil here complained of, but it is only to be wholly removed by the members of the medical profession individually taking up the study of morbid anatomy as a distinct and integral part of medical science.

It is essential to the apprehension of the numerous phenomena presented by morbid anatomy that they should be reduced to a systematic classification. Although in such a classification we must have nature for our guide, the divisions and subdivisions must in some degree be artificial, consequently various systems may be constructed according to the various views of those who may undertake to make them. The following, which is given as a specimen, has been found practically convenient; and as, in the present case, it will serve as a key to some of the observations which will follow, it will illustrate the truth of the observation, that classification is necessary. Deviations from the normal state may consist,

1. In deficiency.
    a. The result of suspended development.
    b. The result of loss sustained, or privation.
2. In excess.
3. In alteration of form.
4. In appearances which may be regarded as the result of ordinary inflammation.
5. In appearances which are the result of scrofula.
6. In appearances which depend on diseases called malignant, or which resemble them in structure, viz.,
    a. The adventitious production of cysts, generally pedunculated, and assuming the form of reflected membranes, erroneously called "Hydatids," and which are often

unaccompanied by constitutional affection or taint.

- b. True scirrhus,
- c. Fungus hæmatodes or medullaris, medullary sarcoma, fungoid disease, spungoid inflammation, cerebriform cancer, &c.
- d. Melanosis, in that particular form which exhibits a structure resembling the preceding, to which the term "melanosis," as descriptive of a specific affection, may, for convenience and precision, be restricted.

7. In Hydatids or other parasitical animals lodged in the particular organ.

8. In the effects of accidental injury.

Deficiency.—This may proceed from two causes: it may be the result of original defect, or the part having existed in its original state may have suffered loss. From either of these causes the deficiency may be absolute and total, in which case we have only to consider the causes which have led to it; but before admitting total deficiency, it is essential carefully to ascertain that the part in question is not in existence, either as a rudiment, or debris.

If the part continue to exist, it may be the subject of deficiency either by a general diminution of size, or by the total or partial absence of some of its subordinate parts.

Excess.—Excess admits of varieties in some respects analogous to those which have been noticed in the case of deficiency. A part may be preternaturally large from original formation, as we sometimes see to be the case with a child's head, in other respects perfectly well formed, or the enlargement may be secondary, as when the enlarged head is the result of a morbid collection of fluid in the ventricles of the brain. Sometimes the excess of one part is the result of deficiency in another, as, for example, one kidney being suppressed or destroyed, the other acquires increase of volume, as well as of function. Sometimes increase of size, or hypertrophy as it is called, is simply the result of increase of function, as, for example, when the heart becomes enlarged in consequence of various causes rendering the circulation of the blood more difficult. In some organs great variations in size may take place independently of disease, and in obedience to the laws of nature. The most striking examples of this kind are seen in the inferior animals, as, for example, in the vernal increase of the size of the frog's thumb, and in the prodigious enlargement of the testes of some animals about the same season. Excess may consist in the increase of the number of organs, as, for example, when, instead of one spleen, we find four, or even five. Instances are by no means rare of the hand having six instead of five fingers. Examples of excess like the last-mentioned take place in conformity with the law pointed out by Bichat, viz., that the component parts of limbs increase in number as they become distant from the trunk or centre; thus the upper arm has one bone, the humerus; the fore arm two, the radius and ulna; the carpal rows have each four, and the metacarpal five, which, in the abnormal cases above-mentioned, are increased to six. Excess in number sometimes takes place in the parts of organs rather than in additional entire organs, as, for example, when the lungs or the liver are divided into an unusual number of lobes. Excess with respect to the number of organs or parts of organs, in the human subject at least, may be always said to be congenital; but whilst in some instances this anomaly is the result of original mal-conformation, as in the case of six instead of five fingers, in others it is the consequence of the persistence of parts which, in the ordinary progress of growth, are suppressed in their development. Of this description are supernumerary ribs and the os coccygis prolonged into a tail, or parts originally formed in two portions destined to be ultimately united may fail to become so, as in cases of hare-lip and double uvula. Although in the human subject excess in number appears to be always congenital, in some of the inferior animals it may be subsequently acquired; thus certain reptiles which have the power of re-producing a tail when the original has been amputated, have been known, after injury to that organ, to produce a second, although the first has continued to be attached and nourished.

Excess in the number of organs, or parts of organs, has been ascribed to a kind of compensation, as when a child has been born with four fingers or four toes to the hand or foot, the same mother has given birth to another having six fingers or six toes.

Deviation in respect of form.—Anomaly in this respect may be of such infinite variety, that it would be in vain to attempt to describe it; but its characters are so obvious that description is unnecessary. It may, however, be brought about in various ways: it may depend on original formation, as, for example, when the nose, instead of possessing its usual shape, assumes the form of a trunk,—a kind of monstrosity not very rare in the human subject, and rather frequent in some of the inferior animals, and generally, if not invariably, concurring with the union or near approach of the eyes on the median line.

Perversion of form may be likewise acquired under the modifying operation of some neighbouring influence, as, for example, when the convex surface of the liver is indented by some anomaly in the form of the diaphragm, or when the form of the kidney is distorted by unusual pressure, occasioned by curvature of the spine. Some of the most striking perversions of form of this description are produced designedly by artificial means, employed through ignorance or culpable folly. The practice of moulding the form of the infant's head, so as to produce a remarkable flatness of the forehead, has, from time immemorial, prevailed over a large district of the new world, insular and continental. The practice of distorting and crippling the ladies' feet in China by means of early-applied and forcible compression, is another well-known instance of distortion of this kind. We may find instances equally atrocious without looking beyond the civilized countries of Europe. Even in some of these the form of the head is often injuriously, as well as disfiguringly distorted by the application of bandages. An excellent pamphlet on this subject has recently been published by Dr. Foville, who has not merely pointed out the perversions of form generally produced, but has also shown, from careful statistical inquiry, the serious influence exerted on the intellectual faculties in strongly disposing to epilepsy and insanity. There is, perhaps, no distortion of this kind which is more frequent, or more injurious and culpable, than that which is practised on the chests of females by tight lacing, employed with a view of producing a slender waist. The lower ribs, which should form the base of a cone, are so coerced as almost to form its apex, and instead of admitting of the most extensive motion they are rendered completely fixed, to the most serious interruption of respiration; at the same time the diaphragm, and likewise the abdominal viscera, are deranged both in form and function.

There are some morbid perversions of form, which, although existing from birth, may be ascribed to the influence of a modifying force applied to the distorted organ, rather than to any inherent vice in the *nisus formativus* of the part. Club feet, and other distortions of the limbs, may be regarded as of this class, and referred to causes which have acted upon the fœtus *in utero*. The umbilical cord has been supposed by Geoffroy St. Hilaire to influence some of these distortions by preternatural shortness, or by malposition.

Distortion of form sometimes takes place in consequence of the concurrence of a diminution in the resisting power of a part in conjunction with the application of a modifying force applied to it. Although in this form of distortion a change of tissue is concerned, it is necessary to notice it under this head, since the distortion often continues after the morbid condition in the texture of the part has ceased. The heads of children sometimes have such an unusual degree of pliancy that they lose their symmetry by their own weight, and if allowed to remain constantly or generally in one position, the loss of symmetry becomes permanent. I have observed the progress of this loss of symmetry in children labouring under acute affections of the head, in whom the natural pliability of this part appeared to be considerably increased, whilst the cause of distortion occasioned by the child lying for the sake of ease in one position was probably increased by the weight of accumulated fluid in the ventricles of the brain. I have known this distortion almost entirely removed, although it had become very considerable, on the child's recovering health and strength, which allowed the position of the head to be variously changed; but we often meet with individuals, in whom a want of symmetry of this description has become striking and permanent. A distortion of this kind is very frequent in heads brought from the South Sea Islands, and I have been informed by W. S. Stuchbury, formerly naturalist to the South Pacific Pearl Company, that this want of symmetry was obviously occasioned by the mode of nursing infants, which allows the head to rest on the lateral and posterior part.

There is another form of distortion of the head which is not very common, and does not appear to have been specially noticed, which would seem also referable to a transient morbid state. The upper and lateral part of the cranium on each side becomes flattened and depressed, so as to give the upper part of the head the form of a ridge, taking the direction of the sagittal suture. Without the assistance of any history to explain this peculiarity of form, it seems not unreasonable to regard it as the result of the absorption of a preternatural quantity of fluid in the ventricles, taking place after the process of ossification had closed the fontenelles; so that the necessary diminution of the capacity of the skull could not be brought about at their expense.

Some very serious and disfiguring distortions of form belong to the section now under consideration. Perhaps the most remarkable and important of these, is the distortion of the pelvis, occasioned by the combined influence of the weight of the body, and the resistance of the heads of the thigh bones, when the individual is standing. When rickets, or other morbid conditions, have greatly reduced the resisting power of the bones, the distortion thus produced is so considerable and irremediable, as to render parturition impossible without death to the mother or child, or to both. Great distortion of the leg bones is frequently brought about by a similar concurrence of circumstances, and many children have grown up in a state of unsightly deformity, in consequence of having been allowed, or even compelled, to stand or walk whilst their limbs were in a state of morbid weakness: the evil is in many cases rather aggravated than remedied by the application of irons with the view to counteract it.

The fourth head comprises those deviations from the normal state which are the result of the *inflammatory process*. The most numerous and most important pathological conditions belong to this section. It will not be necessary on the present occasion to enter into the consideration of the knotty subject of the intimate nature of that condition which we designate by the term inflammation, we may rather refer to the article under that head, and in the mean time, we may take for granted, that the term is sufficiently understood to mark the distinction to be made between the subjects falling under this head, and those which belong to other sections.

In observing and describing the appearances resulting from inflammation, it is necessary to distinguish those which depend on its recent, from those which belong to its advanced state, and those which it leaves behind it, when it ceases to be in operation. It is also necessary to distinguish the acute from the chronic form. The phenomena of ulceration and suppuration manifestly fall to be considered under this head; but they necessarily require subdivision, independently of that into the acute and chronic before alluded to, seeing that there are inflammations of a specific character which greatly modify the appearance of the affected part, as well as the general and local symptoms which attend them. Thus, we have the specific ulceration of venereal origin; closely allied to which, are those produced by sibbins and yaws. The virus discharged from a glandered or farcyed horse produces an untractable, and often fatal ulceration, which also appears to be of a specific character. The ulceration with which sweeps are liable to be affected from the influence of soot seems to be produced by an inflammation of a specific kind; and though designated by the term, Chimney-sweeper's Cancer, appears to be totally distinct from those affections, which can with propriety be included under the term cancer, even in its most comprehensive sense, since these affections, though regarded by some as modifications of the inflammatory process, are unquestionably distinct from it, and form a peculiar class by themselves. Notwithstanding the preceding remarks, it will be proper to observe, that parts to which some of the forms of cancer have given rise as an adventitious structure may, like parts natural to the body, become the subject of decided inflammation. This circumstance may serve to account for the error of those who have fallen into the confusion above alluded to. Amongst the phenomena dependent on inflammation, it must be noticed, that there are not merely those which consist in alteration of the tissues affected by the morbid process: there are others dependent on the formation of a new material, which is to be regarded as the product of parts whilst under inflammation. The differences in the character of this product may be regarded as important indications of differences in the process itself. Thus, sometimes, the inflamed part pours out a fluid which has the power of coagulating, and having done so, of receiving vessels, which are *elongations*, or *prolongations* of the vessels of the inflamed part. The product of inflammation thus becomes a new structure, which is either placed upon the old, and is consequently recognisable as an added part; as, for example, when layers and bridles of adhesion unite the opposed surfaces of the pleura, or the new structure may be intimately blended with the original tissue, adding to its bulk and density; as, for example, when the substance of a serous membrane itself appears to be thickened; or more remarkably, when a portion of cellular membrane having been infiltrated with this kind of product of inflammation is not only increased in bulk, but may be so altered in its structure as to lose the character of cellular membrane, and rather resemble cartilage or fibro-cartilage. When this change has been effected, it is important not to confound it with the result of a very different process, and regard it as of the nature of scirrhus. At other times the product of inflammation, whether in the state of fluid or solid, is altogether incapable of becoming organized, and if retained by the system, must be regarded as acting the part of a foreign body. Differences in the product of inflammation of the kind just described, have been noticed as marking the adhesive and the suppurative stages of inflammation, or as denoting differences in the mode of inflammation dependent on the tissue affected. Thus, the first, or the adhesive form has been said to belong to the serous membranes; and the second or the suppurative, to the mucous. Although there can be no doubt that the one form may succeed to the other, and that different tissues are more liable to be affected by the one than by the other, it does not appear to be strictly correct to regard them either as different stages of one process, or, as consisting of modifications simply dependent on the variety of tissue affected. The character of each of these forms may be exhibited by nearly, if not quite, every living tissue, and may also exist independently of the other from the commencement of the attack. Whatever view may be taken of the relation which these two forms of inflammation bear to each other, it is essential to distinguish them in morbid appearances, and it would doubtless be of incalculable importance with respect to the mode of treatment, could they be satisfactorily distinguished during the progress of the malady. There are many intermediate varieties between these two forms of inflammation, and some curious and important phenomena appear to depend on their combined operation.

The term *erysipelatous*, which is sometimes employed to designate a particular form of inflammation, appears to require some comment. A difficulty appears to have arisen in consequence of the laxity and want of uniformity with which it has been employed. Some seem to consider it essential that a certain degree of vesication should be present; in which case, it can only affect parts furnished with an epiderm; others, again, employ the term as expressive of a form of inflammation, which has a considerable disposition to spread, and does so without exhibiting any distinct line of demarcation, or meeting with any obstacle to its progress. With some, the production of pus is held to be incompatible with erysipelas, whilst others admit a phlegmonous form of erysipelas.

Sphacelus and gangrene may also be considered under the head of inflammation, since, though not invariably the result of that process, they very often are so, and are always accompanied with a change somewhat allied to it.

Under the fifth head are arranged those deviations from the healthy state which depend upon scrofula or struma. It must be allowed that there is very sufficient ground for questioning the propriety of separating the phenomena of scrofula from those of inflammation, since it is most probable that it consists in a variety of inflammation rather than any distinct process; there are, however, so many peculiar conditions attendant both on the local and general appearances, and they constitute so important as well as so marked a class of derangements, that there is a manifest practical advantage, although, possibly, some irregularity in making this division, which, however, is sanctioned by the view which has been entertained by some pathologists respecting the nature of scrofula. The most striking feature of scrofula is the production of a new material, which has been called scrofulous or tuberculous matter, in one or more parts of the system. It is met with under several varieties which appear to depend on changes which it may undergo from its first formation, till its expulsion from the body, or till it acquires a form in which it may remain quietly lodged in the system; nevertheless, some of the differences which it presents may depend on varieties of the strumous state, or on the peculiarities of the parts in which it happens to be situated.

By some pathologists, at the head of whom may be placed Laennec, who has carefully studied the phenomena connected with tuberculous matter situated in different parts of the body besides the lungs, it is considered that this material commences in a semitransparent and gelatiniform state,—that it subsequently becomes opaque; for a time acquires an increased density, but ultimately undergoes a process of decay attended with softening commencing at the central part of the mass, and thence extending to every part, and preparing the way for its expulsion through an ulcerated opening formed for its exit. Andral, another highly respectable authority, denies the conversion from the semitransparent to the opaque state, and considers that tuberculous matter is formed at once opaque and friable, that there is often no semitransparent deposit, and that when there is, it is not to be regarded as the early state of the tuberculous matter, but rather the nidus in which it is deposited. Laennec and some of his disciples have considered tuberculous matter as an accidental tissue. Others, amongst whom Andral may again be mentioned, regard it as a secretion, and in pathological classification closely allied to pus. This latter opinion appears to be more correct; nevertheless, it must be observed that although tuberculous matter is incapable of organization, or of maintaining life in connexion with surrounding parts, it does, however, undergo changes in which vitality is concerned; and if the transparent gelatiniform state be admitted, which is by no means disproved, it would seem that in its early stage it approaches to the character of that plastic product of inflammation which is susceptible of organization, whilst in its advanced stage it is as inorganizable and excrementitious as pus itself. The possibility of tuberculous matter being susceptible of absorption, or not, has, like some of the points already alluded to, been the subject of difference of opinion and controversy.

The question is one of practical importance, since upon it will depend the propriety of pushing the use of some active agents with the hope of producing absorption, which would not only be useless but objectionable were the idea of absorption wholly inadmissible. The fact is probably this; that the absorption or non-absorption of a scrofulous enlargement, must in a great measure depend upon the stage at which the swelling may be, when the attempt is made. Although the existence of a peculiar material designated by the terms scrofulous, tuberculous, or caseous matter, is the most striking and most decisive characteristic of scrofulous derangement, yet the general characteristics of a strumous constitution, and even some local derangement may take place prior to the existence of any of this material. The intimate structure of parts seems to undergo a change by which the proportion of their elements is affected. Thus, the bones in young subjects contain less than the ordinary proportion of earthy matter, and are consequently liable to distortion from the child's own weight, or the application of some external force. The absorbent glands are often paler, and seem to contain a large proportion of fluid parts. The brain, and perhaps some other soft parts seem at times to receive a more than usual quantity of blood, and appear preternaturally vascular. With this change of texture, there is often an alteration in size as well as figure, the bones, especially towards their extremities, become enlarged. This is often strikingly the case with the absorbent glands, and hypertrophy of the brain itself is not very uncommon in children. The state of the constitution on which these changes depend has not inaptly been styled strumous cachexia, and is well deserving of the most serious attention on the part of both medical and surgical practitioners. Some excellent observations have been made respecting it by Dr. Todd, and they have been carried out to a further extent in the very valuable work of Dr. Clarke on consumptive diseases. For the various appearances and stages of tuberculous matter, in different organs, and for an interesting inquiry respecting the comparative frequency with which they are affected, the works of Laennec, Louis, Andral, and Lombard, and that by Dr. Clarke already mentioned may be very advantageously consulted. For the external or more strictly surgical peculiarities of scrofula, treatises on glandular tumours, affections of the joints, and on lumbar and psoas abscess, by English and foreign surgeons, may be referred to: amongst these the following may be enumerated:—Pott, Brodie, Lloyd, Goodlad, Syme, Blackburn, (in the Guy's Hospital Reports,) Chopart and Carmichael.

The next section comprises a very distinct and very interesting class of morbid structures, which essentially consist in a new growth superadded to the parts in or upon that with which they are connected. It comprises the following principal divisions:—non-malignant compound serous cysts; cancer; the varieties of fungoid disease, viz., fungus medullaris, fungus hæmatodes, gum cancer, and melanosis.

The characteristics of this section being dependant rather on structural arrangement than on the chemical or physical properties of the substance upon which the peculiar form is impressed, we shall find that some of these growths are analogous to those natural to the body, whilst others are heterologue, or differing from them. The variety placed at the head of this class, and which, from the clearness with which its parts are distinguished, may be regarded as typical of the family, are of the first or analogous kind, whilst those which succeed comprehend all the most important heterologue structures which the bodies of animals are liable to produce. In the infancy of the science of morbid anatomy, the terms employed to designate most of the affections comprised in this group were extremely vague and very irregularly employed. every enlargement, in a part, might be called a tumour, and everything hard, scirrhus. It was an improvement in technical precision which recognised the family of malignant diseases, and distinguished them by the common appellation of cancer. Further inquiries showed that further subdivisions were necessary, and it happened, somewhat remarkably, that the investigation of cancer was carried on almost simultaneously by different individuals both in this country and on the continent. Bayle, Laennec, and Cayol, in France, distinguished encephaloid and melanotic tumours from the group of ordinary cancers; Laennec also pointed out other forms of disease of this class, namely, gum cancer and cirrhosis. He likewise studied the anatomical character and progress of these affections, and noticed their generally rounded figure; the cysts by which they are so generally invested; their original softness or fluidity; their subsequent consolidation; and their ultimate softening commencing at their centres. He, moreover, insisted on their existence as new and adventitious structures in opposition to the opinion of some contemporary teachers, who held that they ought to be regarded as mere degenerations. In this country, the same subject was investigated by Abernethy, Langstaff, Wardrop, and some others. Medullary carcinoma, spongoid inflammation, fungus hæmatodes, and fungoid disease, are the names employed by these authors to designate the most important of these affections, cerebriform, or medullary cancer. Since the attention of the profession has been turned to this subject by the inquirers just enumerated, several other authors have treated of these derangements either generally, or as affecting particular parts. Amongst the works thus produced, I may be allowed to refer to that, little as it is, which I have had the satisfaction of contributing to our knowledge of the anatomical character of this class of diseases.

From the careful examination of a great number of these adventitious growths, from the most distinct to the most obscure, I have arrived at absolute conviction that they all depend on one essential mode of formation, which allies them to the compound serous and mucous cysts, which possess the greatest distinctness, and are, perhaps, of the most frequent occurrence in the ovaries and their neighbourhood.

The numerous varieties of form and texture which we meet with in this extensive group of morbid productions, may, when this key is obtained, be satisfactorily referred to certain modifications of the cystic character, to different proportions of the fluid and solid parts, and to the nature of the material to which this particular structure or arrangement is given.

This remarkable form of adventitious productions is found in other classes of mammalia besides man, and has also been met with in birds.

So general and marked a type points to the operation of some common laws dependant on the properties of the material so organized[1].

The morbid appearances dependant on the existence of hydatids and other parasitical animals, require, for more reasons than one, to be placed in a distinct and separate class. In the first place, they are attended by phenomena peculiar to themselves; for whilst they exist as foreign substances in the texture of the body, they differ from every other foreign body so lodged, in possessing a proper life of their own, in virtue of which they increase in size, and sometimes acquire enormous dimensions, and consequently occasion progressive displacement and modification of the part in which they are lodged. The circumstance of their possessing this independent life, appears to be the cause of their producing little or no irritation of the parts in which they are lodged, during the early period of their existence: nevertheless, their death at a subsequent period occasions their undergoing those changes which may render them the cause of the most serious and fatal disturbance. Another circumstance which renders it important to give separate and distinct attention to this class of morbid productions, is the possibility of confounding them with phenomena belonging to the two last mentioned classes, a palpable error into which some noted pathologists have actually fallen.

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[1] See Lectures on the morbid anatomy of the serous and mucous membranes, vol. i.

The last division comprises a very great number and variety of morbid appearances, in which many of the characters already named will be present. It embraces all those derangements which are the result of accidental injuries.

The classification of pathological alterations, of which an outline has just been sketched, may be applied to different parts in various methods.

That which is founded on the divisions of general anatomy, is the most convenient for the elucidation of the subject in a course of lectures.

Other classifications may be more advantageously employed, both for the arrangement of the preparations in a museum, and in treating of pathology in connexion with symptoms; since for both of these purposes it is desirable to bring together *the derangement of a particular part, or of the apparatus of a particular function.* I believe that the classification exhibited in the second table of the catalogue of the Museum of Guy's Hospital will be found as convenient as any which has been proposed for these objects.

Pathological anatomy, like most other subjects which have of late years become the matter of special attention, has acquired a nomenclature of its own. Although a good and expressive nomenclature in any science is unquestionably a great advantage as an aid to classification, and in affording great facilities to description by saving endless repetitions, and long periphrases; there is also no doubt that nomenclature may be abused to the incumbrance and obscurity of the science to which it is applied.

Morbid anatomy is not free from this evil, although it exists to a less extent than is the case in some other departments of science, which relate to more numerous and complicated objects.

Although the terms employed by pathological anatomists are already sufficiently numerous to render a good glossary an important desideratum, it is less in the number of the terms newly invented than in the mode of their application, that the principal cause of obscurity exists. I shall not attempt to pursue this subject at present, since it might be extended to many pages, but I shall adduce a few examples by way of illustration.

Many of the terms employed in pathological anatomy, show by their etymology, more or less of the meaning which they are designed to convey, as may be seen in the words *hyperæmia, anæmia, hypercrinia, and acrinia,* employed by Andral; and in the terms *epiphlogose, metaphlogose, hyperphlogose, osteosclerose, osteophile, gonocace, spondylocace, phlebectasie,* and many others made use of by Lobstein. In some other words the meaning is still less concealed, but being designed to convey the idea of a resemblance which can never be exact, and literally susceptible of acceptation, the application must be vague and indeterminate. Of this description are the terms *pancreatic, lardaceous, miltlike,* and other terms applied to tumours.

The difficulty, in many instances, does not depend on the obscurity of the meaning, but rather on the vagueness and laxity of the application, the same term being either applied to different objects at different times, or made to embrace a variety of objects essentially distinct. The word *hydatid* is an illustration of the statement which I have just made. From its etymology, it may be said to be applicable to any cyst containing a watery fluid, and as such, we find it made use of in speaking of those watery vesicular bodies which are occasionally found in the structures of the body, but not having any direct connexion with the parts in which they are lodged, give evidence of a distinct life of their own. Such are the *acephalocystis*, the *echinococcus*, and the *cysticircus*. The term *hydatid* is likewise applied to the cysts not uncommonly found in the *plexus choroides;* to those which either singly, or in numerous association, are found more or less imbedded in the glandular substance of the kidneys; to the serous and mucous cysts, which constitute subordinate cysts in various cases of ovarian dropsy and other similar tumours. It is also applied to those vesicular bodies which are occasionally expelled from the uterus, and which bear some slight and imperfect resemblance to blighted bunches of grapes. The term *hydatid,* thus loosely employed, may possibly not be accompanied by any confusion of ideas in the mind of the person using it; but in many instances it has been so, and a doubtful or confused idea must necessarily be conveyed to the mind of the reader or hearer.

The word *tubercle*, evidently implying a small tumour, and its derivatives *tubercular* and *tuberculous*, afford a striking example of the employment of the same word to convey different meanings. Sometimes it is employed with reference to the form and size of the body described, as when we say a *scrofulous tubercle, a scirrhous tubercle,* and *a melanotic tubercle.* At other times, the term is designed to convey a particular idea of the material of which the body spoken of is composed, and is therefore used whether the body be small or large; whether it possesses a rounded figure, or is diffused in the form of an irregular mass. In the latter sense it is used by Laennec, Beclard, and Andral; by some other persons it is used occasionally in both senses. The word *scirrhus* as I have before remarked, is sometimes used to designate a particular and fatal disease; and at other times it merely implies that considerable induration has taken place.

The word *hæmatome*, implying a bloody tumour, is obscure and indefinite, not because it is employed in different and distinct senses, but because it points to a character which cannot be properly employed as a ground of distinction. Thus *an aneurismal sac* is a tumour containing blood. The capacious cells, which occur in some cases of fungoid disease, may be filled with blood, or bloody serum, and constitute a *hæmatome.* A simple serous cyst may also have its contents become bloody, and constitute another variety of *hæmatome.* Again, the vesicles of De Græfe are sometimes greatly distended by blood and bloody fluid, and thus become instances of *hæmatome.* Extravasations of blood may also take place in parts well supplied with that fluid, and constitute a *hæmatome*, or bloody tumour, as it is sometimes seen in the thighs and other muscular parts.

Without prolonging this article by a lengthened discussion of the subject of nomenclature, it may not be out of place to urge the importance of acquiring clear ideas respecting morbid conditions as they actually present themselves, and of cultivating the art of describing them with accuracy and precision, rather than seeking to fill the memory with a host of technical terms which can scarcely serve any other purpose than an useless display of erudition.

There are some conditions of parts deviating from the healthy state which require to be noticed, although they do not appear as characteristics of any of the sections into which pathological conditions have been divided in the arrangement just exhibited. They have not been employed as distinctive characters, because they may occur under different sections.

Preternatural softening of textures.—This condition may occur under various circumstances, and in various modes. It may happen to parts undergoing progressive wasting from the removal of the dense or solid parts, as sometimes happens to the bones of old persons, whence their fragility, as especially seen in the neck of the thigh-bone.

It may also take place in conjunction with preternatural or excessive growth, the textures not having as yet acquired the firmness which interstitial deposit ultimately gives to them. Thus, the brain of a child affected with hypertrophy, is apt to be soft and flabby. The bones sometimes exhibit a partial hypertrophy, in the early stage of which they are preternaturally soft, although they may ultimately acquire the ordinary firmness. Most newly-formed parts possess a softness of this description. We see this in the granulations produced in the formation of a cicatrix, in the callus which unites the fractured extremities of bones, and also in the early stages of exostosis.

The most numerous and remarkable instances of softening doubtless occur amongst the phenomena dependant on inflammation. The afflux of blood and other fluids, which is one of the first effects of inflammatory irritation, by increasing the proportion of fluid parts, causes a state of softness somewhat like that of newly-formed parts; but the tension with which these fluids are contained in the inflamed texture, not unfrequently during life, masks the softening which has been produced. The most important softening produced by inflammation is that which takes place when the process has been longer in operation; a portion of the solid material appears to be removed by interstitial absorption, whilst whatever new deposit takes place, as the product of inflammation, is a soft, if not a fluid material. It would also seem that during the existence of active inflammation, the original solid parts really have their cohesion impaired and become soft. Whether this depends on the suspension of the ordinary nutrient process, on an influence exerted upon the texture by the fluids of the part in consequence of altered properties in them, or on the diminished resistance in the solids themselves, with reference to the solvent power of the fluids, must at present be a matter of pure speculation which does not affect the fact itself, which may be brought about by one or all of these causes. Illustrations of this kind of inflammatory softening may be seen in all the numerous cases in which death takes place, preceded by some acute local inflammation. It may be seen in all the tissues,—not unfrequently rendering them susceptible of division without the use of a knife; but it is most remarkable and general in the cellular membrane, not merely allowing the easy separation of part from part, but also admitting of the subdivision of parts themselves; thus, recent carditis allows of the ready separation of the muscular fibres of the heart amongst themselves. The coats of an inflamed intestine are often still more readily separated, and many feet of mucous membrane may, without resistance, be torn from the peritoneal and middle coats. The effect of inflammatory softening upon the arteries and capillaries of an inflamed part, constitutes a very remarkable and important phenomenon. If we examine with a moderate magnifying power the small but injected vessels of an inflamed part, on which its preternatural redness depends, we shall often find that these minute vessels have lost their defined outline, and by giving way to distension at some particular points more than in others, occasion an irregular and spotted appearance of the injected surface. The minute vessels thus weakened are also of so soft a texture, that the slightest force is sufficient to rupture them; indeed, it would seem that this sometimes takes place spontaneously, and extravasation of blood is the consequence. This softening of the vessels may, therefore, thus become the cause of the admixture of blood with the solid or fluid products of inflammation, as in the case of hæmorrhagic pleurisies mentioned by Laennec and others. The most important softening of the vessels is that which takes place when the product of inflammation is susceptible of organization, since it would appear that the minute extravasations to which it gives rise are the commencement of the new or elongated vessels by which the new texture is to be nourished. This interesting phenomenon in the process of inflammation does not appear to have received all the attention which it deserves, and the production of vessels in coagulable lymph, which is in process of becoming organized, has in consequence been made the subject of curious speculations. It has been supposed that vessels were spontaneously produced in the organizable material, and made their way to the vessels of the original structures with which they found means to inosculate, and wandering bubbles of air passing through the plastic material, have been referred to as the agents by which the canals destined to become blood-vessels are formed.

Softening of textures, as the result of inflammation, instead of being a step to future organization, and, consequently, subservient to the preservation of the life of the part, is sometimes more closely allied to sphacelus, and may indeed be regarded as the commencement of that state. We see this kind of softening in muscles and other soft parts which have received severe contusion, and are about to slough. The lungs, liver, spleen, and other internal organs, when they have been the seat of a severe and fatal inflammation, are often found in a state of softening, which appears to be of this kind—the most striking examples of which are, perhaps, to be seen in the pneumonia of the dying, and in that condition of the spleen which is common in pernicious fevers.

When sphacelus or gangrene has actually taken place, softness, marked by great lacerability, is the notorious consequence. There are other cases of softening probably allied to some of those which I have just enumerated, which it seems necessary to mention, since the mode in which they are brought about is not very apparent, and the existence of any thing like inflammation in their production may be questioned. I allude to the softening of inter-articular cartilages, and of the inter-vertebral substance, and to some forms of softening of the brain, which seem to belong to this class. In these instances, the vitality of the parts is evidently reduced; but the effect of a preternatural stimulus, which is, perhaps, essential to unequivocal inflammation, is not to be discovered in the softened part, although it may be very apparent in some of the neighbouring parts.

The opposite state, or preternatural hardening, may, like preternatural softening, be produced in a variety of modes. It sometimes concurs with the wasting of parts; the fluid and soft parts being removed, whilst the solid are not only more or less left behind, but are brought into closer approximation, as we see in the round ligament of the liver, and in the remains of the umbilical arteries and urachus. It may also concur with hypertrophy and perversion of form, as in hardening of the spleen, and hardening of the cellular membrane and skin; but, in these cases, the inflammatory or other process affecting the intimate texture of the parts is more important than hypertrophy, or distortion. It is as the result of inflammation that we meet with the most frequent, and perhaps the most important instances of induration.

As inflammation has been already described as the prolific source of a variety of forms of softening, I must offer a few remarks respecting its mode of operation in producing the opposite effect. In recently inflamed parts, the induration may be rather apparent than real, since the fluids may be increased, and the solids weakened, the increased resistance being merely the effect of tension: in this way injured limbs often feel hard from mere effusion: some forms of *œdema durum* appear to be of this description. When we have a real induration of parts resulting from inflammation, it is, in general, not an immediate effect, but the result of a process requiring more or less time for its completion; the product of inflammation has been poured out, soft indeed, in the first instance, but being susceptible of becoming a permanent tissue, it has united with that in which it has been deposited, and participated in its organization; but when this is accomplished, like other newly formed parts, it wastes, its vessels contract, the fluid parts are removed, whilst the solid parts are brought into that closer union on which induration essentially depends. This induration of the superadded product of inflammation, not unfrequently, also occasions that of the original structure in which it is deposited: the original structure being compressed by the new, with which it is implicated, likewise contracts, and, in contracting, becomes indurated: there is, therefore, with this induration of an organ, a real diminution of size, notwithstanding the additional substance which inflammation has occasioned. The liver furnishes the best and perhaps the most frequent specimens of this induration which seems to be common to all our organs: the induration of the brain, described by Pinel, jun., Rostan, and others, appears to be one of the instances of it.

The most striking instances of induration, which take place as a consequence of inflammation, are those in which the affected structure becomes penetrated with earthy matter, constituting what is commonly called ossification. There are, however, two very different states to which this term is applied. In the one, the indurated structure has the organization, as well as the composition of bone; in the other, the latter only; and may, therefore, with more propriety, be termed petrification, as distinguished from ossification.

Induration is the common and distinctive characteristic of one form of disease of that class to which most, if not all, malignant diseases belong. It is, in fact, so striking an attribute of true scirrhus, that formerly when the language of morbid anatomists was less exact than at present, various indurations of a totally distinct nature were confounded together under this term. It is not only the new growth which is remarkable for its hardness, but also the neighbouring parts contaminated by the disease often become similarly affected.

Colour is another quality of diseased parts, which is well worthy of careful attention, although by no means adapted to become the basis of classification, since a similarity of colour would bring together derangements in every other respect essentially distinct. Nevertheless, in some very striking cases, a well marked peculiarity of colour seems to have given the principal interest to certain affections, as in the case of melanosis, cirrhosis, morbus-cœruleus, chlorosis, and the like. The principles on which these varieties of colour depend, appear only to a very limited and imperfect extent, to have arrested the attention of pathological anatomists.

The division into malignant and more malignant, although of great importance, with reference to the patient, and the symptoms under which he labours, affords a very imperfect distinction with reference to anatomical character. It has already been stated, that most, if not all, malignant structures belong to one of the classes enumerated in the table, in consequence of a striking resemblance of structure; but there are other productions manifestly exhibiting these peculiarities, which could never be regarded as participating in the malignant character. Take, for example, some of the encysted dropsies of the ovaries, or their neighbourhood, and some tumours in the female breast.

The history of the cultivation of Morbid Anatomy is so intimately involved with that of the progress of Medicine and Surgery, that it can be of little importance to sketch it in a separate form. Those who feel an interest in this subject may consult the works of Cruvelhier and Lobstein for a short exposition of what has been done expressly for the cultivation of this branch of pathology. Suffice it to say, in the words of Rostan:—"When a superstitious respect for the tomb forbad to seek in the bodies of the dead for knowledge, which might redound to the advantage of the living, most diseases were regarded as essential and general; and it was imagined that they did not leave any trace behind them. At length, when the light of philosophy had illuminated civilized nations, it became allowable to carry a scrutinizing inquiry into the lifeless human body; and those remains, which were once the prey of worms and corruption, became the prolific sources, whence the most useful truths proceeded.

"From that time, diseases, which had previously only been regarded as derangements of function, were recognised as organic alterations. Mere symptoms lost their ancient importance, and were only valued as indications of organic derangements."

Since this happy revolution in opinion has taken place, Morbid Anatomy has been cultivated with zeal, and its advancement has proceeded with accelerating rapidity. Several important general treatises, and a still greater number of admirable works, elucidating the derangements of particular parts, have been published both in our own and in foreign languages. In fact, whatever may have been the extent of lucrative practice, or ephemeral popular celebrity, which individual members of the medical profession may have acquired by superior address, or the zealous advocacy of particular theoretical speculations, or by modes of treatment, rendered attractive by the promise of extraordinary success, few, if any have assured to themselves permanent reputation among their brethren, (the only competent judges,) whose labours have not been conjoined with researches, in which pathological anatomy has been concerned; whilst very many, who have devoted the most laborious and indefatigable attention to this department, have made it the broad and sure basis on which they have raised the superstructure of their lasting fame. I need only mention the names of Morgagni, of Voightel, of Portal, of Baillie, of Bayle, of Laennec, of Cruvelhier, of Andral, of Louis, and of Billiard, and last, but not least, of Sir Astley Cooper, of Dr. Bright, and of Dr. Carswell.

It is not, however, as the means of acquiring reputation, though well merited, that the advantages of Morbid Anatomy may be most strongly urged; but rather as one of those essential requisites, without which no one can expect to be able to discharge his professional duties with satisfaction to the public, or with an easy conscience to himself.

Although Morbid Anatomy, in the wide range allotted to it in this article has been described as including, not the mere dry detail of numberless repulsive and unconnected facts, but, on the contrary, an assemblage of interesting phenomena, developing some of the most wonderful operations of nature, yet it is in connection with other departments, that its vast importance and value are conspicuous. It lends to Physiology that assistance, for which no artificial method of inquiry can supply an adequate substitute. As the only means of throwing certain light upon internal diseases, it is both the basis and the test of diagnosis; and those who neglect this test of their diagnostic powers, are blindly groping in the dark, whether they are conscious of their situation or not. Morbid Anatomy does not merely enlighten us with respect to those cases of disease which we have unsuccessfully endeavoured to combat: it makes us aware of dangers, which we must be on our guard to avert; and it points out to us the path which Nature takes to reduce to a permanent and comparatively healthy, or unimportant condition, those derangements, which do not admit of perfect restoration; a course in which Nature may be aided, but in which she cannot be opposed with impunity. These advantages are not the only rewards held out to excite to the diligent cultivation of a subject, which, when first approached, may well be thought repulsive. Without doubt, there yet remain important discoveries to be made in Morbid Anatomy in connexion with every organ of the body. It is not every individual, or every year, which will furnish a discovery like that of Dr. Bright, with respect to a particular derangement of the kidneys, or that of Dr. Davies, in elucidation of the pathology of *phlegmasia dolens.*

But by sedulously applying ourselves to the subject of pathological anatomy, we shall be surprised at the frequent occurrence of discoveries of greater or less importance ; and at the fair promises of the field yet open to future research. It is not only in the examination of rare and remarkable cases, or even in studying the various appearances exhibited in the pathological condition of a particular organ, that much may yet be done in this department. There is abundant scope for further labour with respect to the commonest diseases by which our bodies are assailed. All of these call for investigation on a more extensive scale. The collection of cases must not only be numerous, but in all a faithful record must be kept, of the age, sex, temperament, occupations, and habits of the individual ; of the time of year, of the symptoms, and of the treatment and its effects. These particulars must not be confined to the unsuccessful or fatal cases, but should also be extended as widely as possible to those in which the issue has been favourable. With respect to the fatal cases, not only the organ principally affected should be examined, but also the condition of those apparently unconnected with it, should be observed and noted. The aggregate of such observations would become the basis of a statistical inquiry, which, whilst it would do away with many preconceived and erroneous notions, would also bring to light many curious, but unexpected and important results. This process constitutes the numerical system so strenuously advocated, and ably put in practice by that distinguished pathologist, Professor Louis. It would be an injustice to this system to confound it with medical reasoning, and medical philosophy. It is the means, or instrument, (and the most powerful instrument, too,) by which those facts are to be obtained, with which alone a sound medical philosophy can be constructed on the ruins of those systems and speculations which this same powerful engine must level with the dust.

In Paris, a band of youthful and devoted pathologists have combined to bring this engine into work ; and I would fain indulge the hope, that the energies of the rising members of the medical profession in this country may be animated by a generous rivalry, which will not suffer them to be surpassed.

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(*Thomas Hodgkin.*)

ANATOMY, SURGICAL. Under this term modern writers have endeavoured to describe that branch of anatomy which refers principally to the size, form, connexion, and relative situations of the parts contained in divers sections, or regions of the human body ; hence also various other denominations which are now generally understood, viz. anatomy of relations, anatomy of the regions, regional, graphical, topographical anatomy, &c. ; some prefer calling it medico-chirurgical anatomy. Many objections might easily be made to these expressions ; but without dilating upon this subject, we shall at once follow the example of two able authorities, Allan Burns, and Dr. Colles, and content ourselves with the terms which head this article.

It has been asked if there really were such a distinct branch of anatomical science as that named surgical anatomy ? or, in other words, whether descriptive anatomy does not embrace every particularity of that science which can be useful to the surgeon ? A good anatomist, no doubt, is perfectly conversant with all the parts of the human frame, their size, form, and uses ; he can lay bare the most hidden artery with the utmost facility ; he can open the most difficult joint with entire confidence and great rapidity ; to such a person, surgical anatomy will rarely be of importance. But this does not diminish the usefulness of that study ! To the profound anatomist, a knowledge of the accurate relative situations of parts contained in a region is the most difficult to acquire; he may recollect the precise course of the smallest branch of a vessel, or the most minute twig of a nerve; he may know every origin and insertion of the muscles when taken separately, and still he may not remember the exact relative situations of the same parts, when considered collectively. We feel convinced (from actual experience) that, as far as the ordinary practice of surgery is concerned, this branch is the perfection of anatomy! Without it the surgeon will rarely, if ever, be enabled to cut down upon a deep seated organ with as much security and precision as if the parts to be divided were transparent; besides, it will readily be allowed by all professors of anatomy, how seldom a perfect knowledge of that study crowns the student's labours, especially in England, where still, unfortunately, so many obstacles are thrown in his way; for this reason, also, would it not be advisable, instead of compelling the student to aspire to the acquirement of minute anatomy, to direct his attention more particularly to surgical anatomy, which, on account of its practical application, will ever be better engrafted in his memory? It would be well if hospital surgeons were to precede all the great operations with an anatomical display of the similar region or regions upon which they are about to act; they would thus excite a deep interest in the operation, and confer great benefit on the patient, the pupils, and themselves.

Much angry discussion has lately arisen in Paris, concerning the claims to the priority of idea regarding the publication of complete treatises upon surgical anatomy. We have not in our possession all the data upon which to found an impartial judgment; a point, which however is the less important, as it will be discussed elsewhere (History of Surgery). We may safely bestow great praise upon Allan Burns, Colles, J. and C. Bell, Harrison, in this country; on Beclard and Dupuytren for their excellent lectures, and to M. M. Velpeau, Blandin, Gerdy, Edwards, Bourgery, for their interesting labours. In Italy, Germany, and America, works have likewise been dedicated to this subject, which will receive due attention in future papers. The great object of surgical anatomy should be to neglect all those minute details which are found in comprehensive treatises, for the more perfect acquirement of the exact forms, sizes, connexions, and relative situations of the parts contained in the regions; for instance, the surface of the body must be scrupulously examined; the numerous external elevations and depressions are of considerable interest to the surgeon, affording him frequently the most faithful rules for the execution of operations. After the surface of the region, the deeper parts will next occupy the student's care; here, nothing should arrest his observation which is not of practical use. It will be our great aim, after the anatomical investigation, to point out all useful information respecting the various pathological conditions of the regions last described; this will tend much to lessen the great perplexity which the young surgeon has so frequently to encounter in his first operations. Each article will thus be made to conclude with much important matter, which the reader would in vain look for, in ordinary works on surgery and anatomy. These articles will contain no views of *transcendental* anatomy, no discussion of vain theories, or obsolete operations; a plain and practical description of the regions of the body must alone be expected: the student may follow us with his scalpel and subject before him—the best and shortest way to make himself master of surgical anatomy. Many writers have given themselves great trouble about the division of the body into sections or regions; all have differed. M. Velpeau has made many which are neither natural nor of any practical benefit; M. Blandin's method is less arbitrary. As far as possible, we intend following the great natural divisions of the body, and propose calling them by the old names, thus:—Head, face, mouth, palate, arm, forearm, elbow, knee, groin, &c. &c. The most important articles will be accompanied by wood-cut sketches, drawn from nature. In the execution of this task, we shall endeavour to guard against the errors of our predecessors, who, by attempting to represent too many objects in their engravings, have frequently thwarted their end, and rendered them extremely confused.

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(*Claudius Tarral.*)

ANCHYLOPS. See Ægylops.

ANCTERES, obsolete, *ἀγκτῆρες*, fibulæ or clasps, by which the lips of wounds were formerly kept together.

ANEURISM, (*εὐρύνω, dilato,—ἀνεύρισμα*, Gr.; *Pulsadergeschwulst*, Ger.; *anevrysme*, Fr.) is a generic term applied to a tumour, formed either by the dilatation of the coats of an artery, or by blood effused from a rupture or wound of an artery, into the contiguous cellular structure; the term is also applied to a dilatation of any of the cavities of the heart. Under the term aneurism has also been comprehended several diseases, which have no common character, except that they involve the arterial system. Thus, besides the *true* and the *false*, there are the *varicose* and *anastomosing aneurisms*, the *aneurismal varix*, and the *arterial varix*.

The *true* or *encysted* aneurism, properly so called, (*aneurisma verum sacciforme,*) is a tumour formed by the dilatation of a portion of an arterial tube, and the aneurismal sac may be formed by the dilatation of the whole of the tunics of an artery, the two external tunics may give way, or one or both of the internal tunics may be ruptured, the cellular coat of the vessel alone forming the parietes of the tumour, and preventing the effusion of blood amongst the surrounding parts. Some pathologists, and particularly Scarpa, conceived that an aneurism was always formed in consequence of a rupture of some of the tunics of an artery; but it has been clearly proved by numerous dissections, that an aneurismal swelling may be formed without the rupture of any of the coats, and merely by the dilatation of all the tunics of the vessel. When an aneurism is of recent formation, and of a small size, the dissection of the tumour often exhibits a simple dilatation of all the arterial coats; but when the aneurism is large, the internal and fibrous coats of the vessel, or the fibrous coat alone, are lacerated.

The different modes by which an aneurism is formed, or the different conditions of the coats of the artery in an aneurismal sac, are illustrated in the annexed diagrams.

Fig. 54.

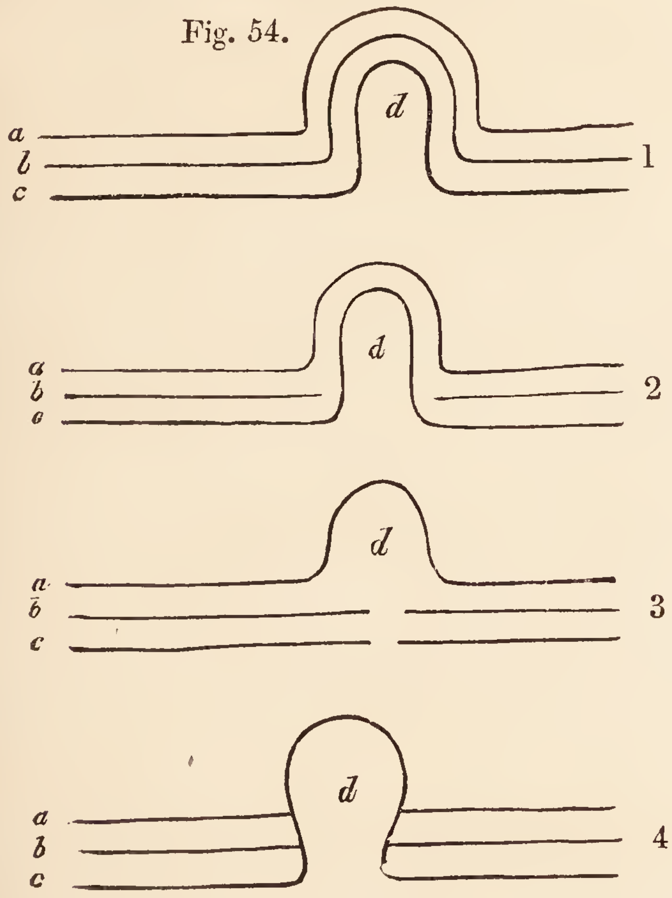

Fig. 1, *represents an aneurism wherein each of the three coats of an artery* (*a*, *b*, *c*,) *are equally distended, and form the parietes of the sac* (*d*).

In fig. 2, the parietes of the aneurismal sac (*d*) *consist of the internal coat* (*c*), *and external coat* (*a*), *the middle coat* (*b*) *having been ruptured.*

In the third, the aneurismal sac (*d*) *is formed merely by the external or cellular coat* (*a*); *the two internal tunics having been ruptured.*

In the fourth, the sac (*d*) *is formed by a distention or hernia of the internal tunic* (*c*), *the external coat* (*a*), *and middle coat* (*b*), *having been both ruptured.*

An aneurism, when situated near the surface of the body, or an external aneurism, makes its appearance at first as a small circumscribed pulsative and colourless tumour, of a globular form, compressible and elastic, attended neither with pain nor inconvenience, disappearing on the application of pressure, and reappearing on its removal. The pulsations of the tumour are synchronous with those of the heart, and if the vessel be compressed between the tumour and the heart, the pulsation of the aneurism ceases, but is again renewed when the pressure is removed. On the other hand, if pressure be applied on the artery on the capillary or distal side of the aneurism, the force of the pulsations of the tumour is increased.

As the tumour enlarges, the pulsations become less and less distinct, and ultimately but a slight thrill is communicated to the hand; and when the tumour has existed for a very long time, and has attained a great size, all pulsation may disappear. Neither can the swelling be now made to subside on the application of pressure, a change which is caused by the coagulation of the blood and the effusion of fibrine within the aneurismal sac.

As the disease advances, the skin covering the sac, stretched and attenuated, turns livid, inflames, and sometimes presents gangrenous spots; the subcutaneous veins become varicose, and if the aneurism be situated in one of the limbs, the whole member becomes cold and œdematous. In this advanced state, the parietes of the sac, becoming so attenuated as to be unable to resist the impetus of the blood, soon give way, and an opening is formed in the gangrenous portion of the skin, which involves the cyst of the aneurism. Should the aneurism extend into a mucous canal, the termination will take place in the same way as on the cutaneous surface; and if it approaches a serous cavity, the sac will either crack or ulcerate. However, in the greater number of instances, an aneurismal tumour advances towards, and ultimately appears at the cutaneous surface.

When a rupture of the tumour has taken place, the coagulated blood contained within it prevents the profuse outpouring of the fluid blood, so that the stream is not continuous, but is discharged at intervals, each jet becoming more profuse and alarming; a fatal hæmorrhage does not immediately take place unless the opening in the sac be large, and the clots of blood are quickly displaced, so that there will be no obstruction to the escape of the fluid blood. Sometimes the blood from the aneurismal sac, in place of bursting through the skin, or into a mucous canal, or serous cavity, escapes amongst the surrounding soft parts, thus constituting the diffused or *false* aneurism.

When the parietes of an aneurismal sac have thus given way, sometimes the tumefied parts become of a livid colour, the skin sloughs, and blood, partly fluid, and partly coagulated, continues to be discharged. The cellular issue being now infiltrated with blood, inflames and sloughs, the discharged clots assume a bright red colour, and at length, fluid arterial blood is poured out. These changes make their appearance with a rapidity proportioned to the facility with which the blood escapes from the ruptured sac, and as the opening in the sac is generally small, the blood escapes slowly, making its way through the cellular membrane to a distance more or less remote, and forming a tumour, the true nature of which it is often not easy to detect; or at a more advanced period, the sac which has been formed of the cellular coat of the diseased vessel now gives way, and the boundary or sac of the aneurism is formed of the cellular sheath of the artery and the surrounding soft parts, all of which have adhered together and become consolidated, and it is only when the sac has burst before such consolidation of the sheath and adjoining soft parts have become sufficiently strong to resist the force of the blood's current, that the fluid blood is diffused amongst the surrounding parts.

Aneurisms produce effects which vary according to the nature of the textures surrounding them, and the regions of the body in which they occur. The pressure of the tumour on particular nerves creates pain along the course of those nerves, gives rise to œdematous swelling by compressing the veins and lymphatics, causes the skin to inflame, and when of long continuance destroys even the contiguous bones.

Aneurisms, when situated near any of the great cavities, sometimes extend into those cavities, and prove fatal by the derangement which the tumour, from its bulk, produces on some vital organ. An aneurism may likewise destroy life by the incessant pain, or by the long duration of the disease producing a gradual extinction of the vital functions.

Aneurisms, however, do not always proceed to a fatal termination; and it happens by no means unfrequently that processes are set up by Nature which effect a *spontaneous cure* of the disease. The tumour ceases to pulsate, diminishes in size, becomes harder, and finally disappears altogether, or is reduced to a more or less firm and solid mass.

The spontaneous cure of an aneurism may take place in no less than *five* different manners, and the principle or the processes which Nature employs for the cure of the disease, is in all of them the same, the parietes of the sac being strengthened by, or the whole cavity filled with, a fibrinous concretion.

1. The first and the most common of these spontaneous processes of cure is effected by the aneurismal sac being so filled up and strengthened with concrete fibrine, that all danger of a rupture of the sac is removed, whilst at the same time the original canal of the vessel remains pervious, and carries on the circulation of the blood.

2. In the second process by which an aneurism may undergo a spontaneous cure, the sac is not only filled with concreted fibrine, but the canal of the artery is obliterated.

3. An aneurism may likewise undergo a spontaneous process of cure by the tumour acquiring such a size and position, that by its pressure on the trunk of the artery, either on the cardiac or on the capillary side of the tumour, the sides of the artery are brought into contact and adhere. (*Home.*)

4. An aneurism may also be cured spontaneously by a process of suppuration in the sac, both the sac and the artery above and below the tumour having previously been filled with coagulum. In such a case, the integuments inflame and adhere to the sac and then ulcerate, and those portions of the coagulum which cannot be removed by the process of absorption, are ejected through the ulcerated opening, allowing the cavity of the sac to be filled up and obliterated by the process of granulation.

5. The fifth mode of spontaneous cure has been observed from the bursting of the tumour underneath the common integument, and the artery becoming obliterated by the pressure of the effused blood. (*A. Cooper.*)

I have observed that the principle on which an aneurismal tumour can be cured by any of these spontaneous processes is the same—all of them depending on the effusion of concreted fibrine within the sac, or both within the sac and a portion of the artery adjacent to the aneurism; and which fibrinous concretion is caused, or is permitted to be formed, whenever the circulation of the blood within the sac becomes preternaturally languid.

On the circulation of the blood in the sac, or in a portion of the artery as well as in the sac, being thus prevented by a fibrinous concretion, another process is afterwards instituted; the former being only to answer a temporary purpose. The concreted fibrine is ultimately absorbed, and the aneurismal sac, or both the aneurismal sac and the artery from whence it originates, gradually contract,—the sac becoming a small fleshy tumour, and the artery an impervious tube. Petit describes the remains of an aneurism of the carotid artery, which had originally been the size of an apple, and after having undergone a spontaneous cure, was found, after death, not larger than an olive.

Whenever the spontaneous cure of an aneurism has been effected by any of the aforesaid ways, it sometimes happens, even after so desirable a change has taken place that the bulk of the tumour alone, in certain situations has continued to cause alarming symptoms, and even to prove fatal. Thus aneurisms at the arch of the aorta, in the arteria innominata, and the roots of the carotids, I have repeatedly seen cause death, even where they had not acquired a very large size, or where the sac was filled with fibrine and completely consolidated.

Fig. 55.

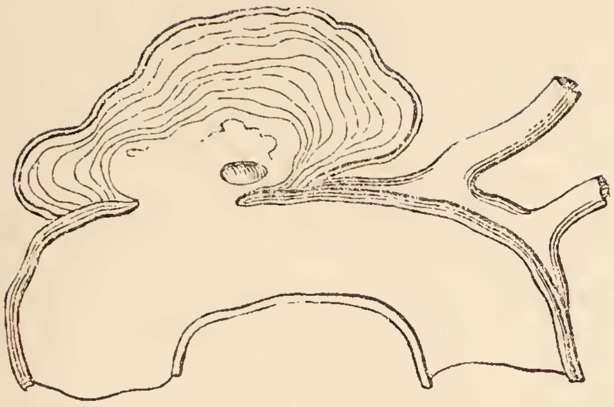

Fig. 55 *exhibits an aneurism of the aorta which has undergone a spontaneous cure by the first mentioned process; the sac is completely filled with laminæ of concreted fibrine, so that there was no longer any danger of a rupture of its parietes. There is a small cavity in the interior of the concretion which communicates with the aorta, and through this cavity, the blood passed into the arteria innominata, the origin of which is observed at the inferior part of the cavity. (Hodgson.)*

Fig. 56.

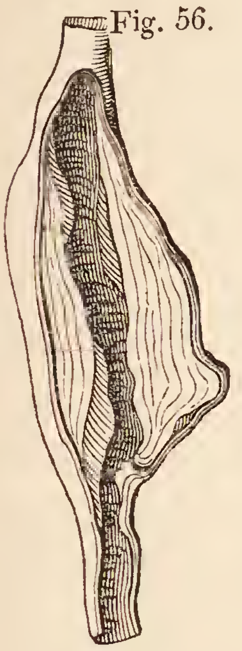

Fig. 57.

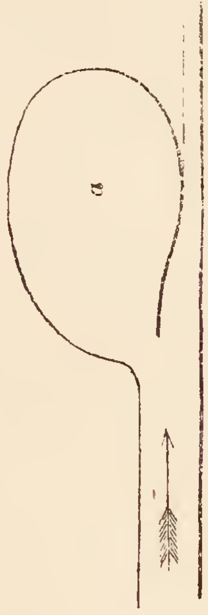

Fig. 56. *The whole circumference of the vessel has become aneurismal, and a spontaneous cure has been effected by the second process which was described. The sac being filled with a laminated fibrinous concretion and a canal left in the centre of the concretion, through which the blood had continued to circulate. The canal is seen of an irregular form, and in some places larger than the calibre of the healthy portion of the artery.*

Fig. 57, *is a diagram explaining how an aneurism may undergo a spontaneous cure by the tumor* (*a*) *acquiring such a form and position that by its pressure on the trunk of the artery* (*b*, *b*), *either on the cardiac or capillary side of the tumour, the sides of the artery are made to approximate.*

Fig. 58.

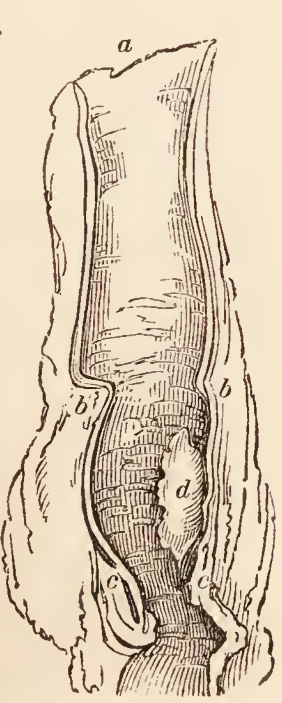

Fig. 58. *The upper portion of the femoral artery, in which the aneurismal swelling had become the seat of suppuration and sloughing. In this patient there was a large aneurismal tumour of the femoral artery, just where that vessel penetrates the triceps muscle. The integuments ultimately gave way from the enormous growth of the tumour; large masses of coagulated blood were afterwards discharged through the ulcerated openings of the skin, and an immense suppurating cavity was thus formed, the profuse discharge from which proved fatal. On dissection, it appeared that upwards of six inches of the femoral artery had sloughed off, and nature had plugged up both extremities of the vessel, by producing a contraction and thickening of the coats, and also the formation of an internal clot. a, is the upper portion of the femoral artery, which at b b, is considerably diminished, and from thence the canal becomes gradually narrower, until at c c, where it is greatly contracted, and terminates in disorganized cellular membrane. The internal clot d, is observed immediately above this ulcerated orifice, and floats loose in the tube of the artery.*

The aneurismal Sac has usually a form more or less globular, and sometimes emerges from the arterial trunk by a neck so slender as to give a pyriform or flask-like appearance to the swelling, (fig. 59).

Fig. 59.

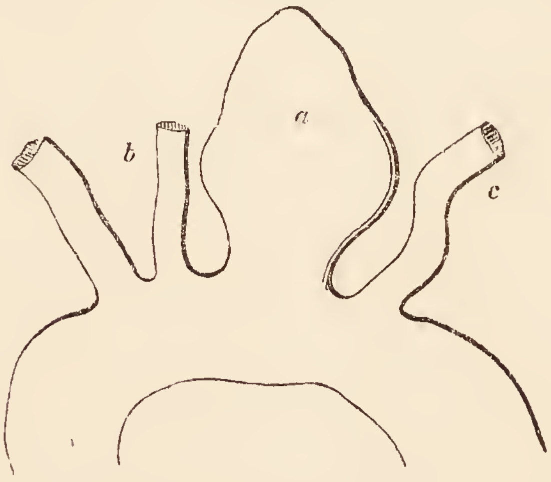

Fig. 59 *represents an aneurism with a very narrow neck rising out from the arch of the aorta. The tumour* (*a*) *of a Florence flask shape emerges from the aorta between the roots of the left carotid* (*c*), *and left subclavian* (*b*).

On examining the coats of an aneurismal artery we find that they have become altered in their structure. The cellular coat is usually thickened, and adheres more or less to the surrounding cellular texture. The proper fibrous coat is paler and less elastic, and the internal coat is more brittle and even more easily torn than in the natural state. Calcareous or chalky-looking matter is frequently deposited between the coats, and osseous scales are sometimes observed covered by the inner tunic; or that coat is destroyed, and the bony matter is in direct contact with the circulating blood. All these changes in the structure of an artery occur, however, independently of any aneurismal swelling, and usually exist prior to the formation of an aneurism. It is, in fact, the diseased state of the coats of the artery which makes them liable to give way, and become aneurismal.

The opening, by which the sac communicates with the artery, is generally of an irregular form, and varies in size; being sometimes very small, sometimes so large as nearly to divide the artery, and sometimes this opening is so large that no distinction can be observed between the parietes of the tumour and those of the artery, the internal membrane of the sac appearing to be continuous with that of the vessel.

Fig. 60.

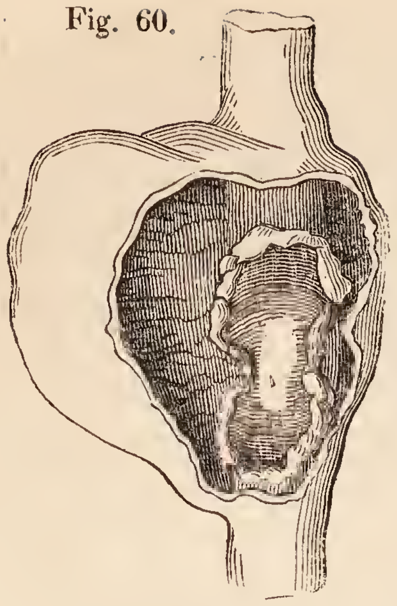

Fig. 60. *The destruction or rupture of the coats of an artery, which leads to the formation of an aneurism, is here illustrated: the thoracic aorta communicates with a sac that had burst into the lungs, the internal coat of the artery was thickened, and at the part where it communicated with the aneurismal sac a portion of the circle of the internal and middle coats had been ruptured and destroyed by ulceration, the lacerated edges being separated to a considerable distance. The external or cellular coat is stript from the fibrous coat to a considerable extent, and forms the sac.*—(*Hodgson.*)

Sometimes the interior coat of the artery is not only ruptured, but portions of that tunic hang loose like fringes, so that they float in the blood. (*Haller*)

"Some have conceived," observes Laennec, "no doubt from the smooth appearance of the opening by which the aneurismal sac communicates with the cavity of the artery, that the internal membrane forms a protrusion or sort of hernia, which extended through a rupture of the fibrous tunic, and after being gradually distended, lines the whole of the internal surface of the aneurismal sac, whilst the cellular coat of the artery forms the external covering. Dubois and Dupuytren adopted this opinion, and they presented some anatomical preparations to the Society of the Faculty of Medicine, to prove that in certain cases the internal membrane extends through the opening of communication, and lines the internal surface of the sac some distance from the opening."

It sometimes happens that when the internal coats of an artery give way, the blood, in place of distending the cellular covering of the vessel corresponding to such rupture, and there forming a common aneurismal tumour, insinuates itself between the cellular and fibrous coats of the vessel, and then becomes extravasated, sometimes to a considerable extent, forming what is called by Laennec, a *dissecting aneurism.* In one remarkable case of this kind the blood was driven through the internal and fibrous coats, and dissected the fibrous from the cellular coat for the space of four inches, and then returned through another rent in the canal of the artery. This new channel of the blood had a coating of coagulable lymph, which had a smooth surface, and the rent in the tunics of the artery was so large as to transmit the greater portion of the blood, so that the original tube had also its direction altered from the compression of the swelling, the newly-formed canal having assumed its place.

Contents of the Sac.—Besides the changes which have taken place in the tunics of an aneurismal artery, the sac will be found to contain two distinct substances,—coagulable lymph, or fibrine, and coagulated red blood. I am not aware that pathologists have distinctly pointed out these two different substances in the aneurismal sac, the word *coagulum* having been employed to designate both the concreted fibrine and the coagulated blood. It is of importance, however, that they should be discriminated when considering the treatment of the disease; and I shall endeavour to show that they are the result of two very different processes.

Fibrine.—When the fibrinous concretion is examined, it is found to consist of numerous concentric laminæ, which are more or less easily separable from one another, and firmer in proportion as they approach nearer to the coats of the sac. The laminæ of fibrine which are in immediate contact with the blood circulating in the sac have generally a flocculent appearance, and have coagula of red blood mixed with them. But in some aneurismal tumours the concreted fibrine has its interior surface smooth and polished, being lined throughout by a membrane which has the appearance, as already mentioned, of being continuous with the lining membrane of the artery. The sac being lined with a membrane of this description shows the power which the system has of reproducing a serous membrane under particular circumstances, in like manner as has been often observed with regard to other textures.

Though the fibrinous concretion in an aneurism can be easily separated from the sac, yet it adheres closely to its internal surface, and I have every reason to believe that there is a vascular connexion existing between them. Morgagni, indeed, doubted the possibility of aneurismal concretions being produced by a mere stagnation of the blood.

Neither the precise nature of the connexion which exists between the aneurismal sac and the concretion, nor the nature of the process by which such concretions are formed, have been accurately pointed out by pathological inquirers. There is evidently a great difference, however, in the anatomical characters of a common clot of blood and a fibrinous concretion; and the coagulated lymph, or fibrine, which is deposited in an aneurism appears to me to bear a strong analogy to the internal clot found in an artery on which a ligature has been placed, and likewise with those polypiform concretions which are formed within the cavities of the heart. Besides the coagulum of blood which is formed within the canal of an artery, immediately after the application of a ligature, and which acts merely as a temporary barrier to the flow of the blood, there is subsequently an exudation of fibrine from the internal coat of the artery, commencing from the place of the ligature, and extending as far up the canal as that point from which the first branch is sent off from the trunk of the artery. This fibrine adheres intimately, and appears to have a vascular connexion with the internal coat of the vessel. In the Hunterian Museum there is a preparation of an artery, the vasa vasorum of which were injected after a ligature had been applied to it, and the internal clot is distinctly reddened with the injection. John Hunter, however, was doubtful whether the red colour of the clot was produced from injected vessels or from effusion. That the fibrinous concretions found within an aneurismal sac are organized also, appears extremely probable, from the masses of coagulable lymph which are found within the cavities of the heart, in many instances adhering to, and having a distinct vascular connection with, the endocardium or lining membrane of the heart; but what appears to me to confirm the opinion of the fibrinous concretion in an aneurismal sac being organized, and being an effusion from the vasa vasorum, is the fact of the coagulum formed in an obstructed vein having been distinctly injected by Mr. Kiernan. A branch of the vena porta had been compressed by a tumour and plugged up by effused lymph, and the arteries having been filled with fine injection, the coagulum was reddened on some points and a very considerable sized vessel is exhibited in the preparation passing from the internal coat of the vein into the coagulum.

Whilst, therefore, red blood may coagulate in an aneurismal tumour, merely by the diminution in the force of the circulation as shall hereafter be pointed out, the formation of an organized fibrinous concretion must be the result of a different process, and can only be explained by supposing fibrine to be effused from the internal surface of the sac itself, in like manner as coagulable lymph is effused on the surface of an inflamed serous membrane.

Coagulated blood.—The coagula of red blood are very distinct, as I have already said, from the concreted fibrine or coagulable lymph which is in immediate contact with the internal surface of an aneurismal sac. Coagula are sometimes found in distinct masses, in contact with the concreted fibrine, and sometimes portions of the fibrinous concretion, which hang loose in the cavity of the aneurismal sac, are surrounded with coagula of blood.

These two different substances, the laminated fibrinous concretion, and the coagulated red blood, both of which are found within the aneurismal sac, ought, therefore, to be discriminated from one another, more particularly as the artificial means which may be adopted to further the production of the one may not be such as are best calculated to promote the formation of the other: and hence, when a surgeon speaks of effecting a coagulation of the blood within the sac of an aneurism, he ought to consider, whether the means employed be intended to promote the formation of a fibrinous concretion, or whether they will merely produce a coagulation of some of the red blood contained within the sac.

The anastomosing vessels.—It has been stated (see Anastomosis) that no sooner is the circulation in an arterial canal diminished, or altogether interrupted, than the anastomosing vessels enlarge to supply the deficient quantity of blood. This change in the inosculating branches is distinctly seen in those of the head, when the carotid artery of the opposite side has been tied; the various ramifications of the temporal and occipital arteries acquiring a very considerable increase in their bulk, and becoming tortuous. But if, during the "spontaneous cure" of an aneurism, the circulation of the blood in the artery be gradually diminished, a corresponding degree of dilatation will take place in the collateral branches. And again, if a ligature be applied to a diseased artery for the cure of an aneurism, from the circumstance of the inosculating branches having been already employed, for a longer or shorter period, in performing the functions of the obstructed vessel, the anastomosing branches will not have to undergo the same degree of change as would have been requisite had the trunk of an artery been suddenly obstructed. It has also been stated, that whilst a vast number of anastomosing branches are, at first, called upon to perform, by their cooperation, the function of an obstructed trunk, the number of dilated branches gradually decreases, and ultimately the function of the obstructed vessel is performed by only one or two enlarged anastomosing branches,—and these are found in the very site of the vessel on which the ligature has been placed. (*A. Cooper.*)

Predisposing causes.—In almost every case of aneurism of spontaneous formation, the coats of the artery have been diseased previously to the formation of the tumour, and even in those cases where the aneurism has formed after some violent exertion, there is always reason to suspect that the coats of the vessel have undergone some previous morbid change. An artery, in its healthy state, possesses elasticity sufficient to preserve its natural calibre, notwithstanding any violent muscular efforts, or any inordinate accumulation of blood. But if the power of resistance of the coats of the artery be diminished in any part of the vessel, it can readily be conceived how the coats may then give way, gradually or suddenly, before the lateral impulsion of the blood, and an aneurism be thus formed. The changes in the structure of an artery, which predispose to the formation of aneurism, are a diminution in the natural elasticity of the coats of the vessel usually accompanied with the deposition of an earthy or calcareous looking matter, or even of bone betwixt the interior and fibrous coat,—all which changes are generally supposed to be the consequence of chronic inflammation. In losing their elasticity, the tunics of an artery are observed to be more or less friable. But whether the changes of the arterial structures are referable to arteritis in an acute or chronic form, or whether this degenerescence takes place from other, and perhaps unknown causes, will be discussed in another place. (See Artery.) If the entire circumference of the vessel be affected, the dilatation will be equal on all sides, all the tunics yielding at the same time; this is the *fusiform* dilatation. But if the change has taken place partially in the artery, and affects only one of its sides, the enfeebled portion only of the tunics will yield, and the dilatation will then be partial. The fusiform dilatation is now regarded by most pathologists as a precursor to the more common lateral dilatation, and in which, if it continues to make progress, it ultimately terminates. An artery, however, may undergo dilatation without any disease of its tunics. But this condition differs essentially from that of an aneurismal sac, and will be noticed hereafter.

Proximate Causes.—Besides different constitutional disturbances, such as arise from rheumatism or gout, and which cause changes in the structure of the arterial system, aneurisms can usually be traced to some violent or sudden exertion, or to some mental excitement. An aneurismal swelling often arises from a violent fit of coughing, sneezing, vomiting, or leaping. A man, who had an aneurism of the innominata was seized with a long paroxysm of sneezing; after which he first perceived the aneurismal tumour. Another person, who had a carotid aneurism, first noticed the tumour after a violent fit of coughing. A third person, on leaping a ditch, slipped; at the moment, he felt a snap in the ham, after which an aneurism formed in the popliteal artery. In another case, a person, on attempting to raise himself in bed, on his hands, felt something snap on the back of his right hand, when an aneurism formed on the radial artery. (*A. Cooper.*) In a word, when the predisposition exists, the disease may be developed by causes apparently slight, acting either directly on the vessel itself, or indirectly on the heart.

How an aneurism is caused by a sudden exertion or violent muscular effort, may, I think, be readily explained now that the influence of muscular contractions on the arterial circulation has been pointed out (vide the author's work on Diseases of the Heart). If the pressure of a contracted muscle on an artery have the effect of diminishing the impetus of the current of the blood, or of arresting it entirely, the result of thus stopping the circulation in a diseased artery must sometimes be such as to cause the diseased tunics of the vessel to give way, and an aneurism to be formed.

Attempts have been made to *imitate* the formation of an aneurism by experiments on the arteries of animals. For this purpose, John Hunter laid bare the carotid artery of a dog, and afterwards "skinned it with a knife, even to transparency," but no dilatation of the vessel took place. Three weeks afterwards, the animal was killed, and the artery on which the experiment was made, in place of being dilated where the external tunic had been detached, was found thickened by the inflammation, and subsequent adhesion of the adjacent cellular structure. The result of Hunter's experiments, however, were in direct contradiction to some which had been made by the illustrious Haller, who asserted, that he could readily produce an aneurism in dogs, by separating the cellular or fibrous coat of their arteries, and leaving denuded the internal tunic. The discrepancy in the results of the experiments of these two eminent pathologists was, however, readily accounted for by the difference of the mode in which their experiments were conducted; for whilst Haller left the denuded vessel to remain isolated and separated from the adjoining soft parts, Hunter allowed the artery and the surrounding cellular tissue to unite, and hence the parietes of the vessel, in place of being more yielding, as in Haller's experiment, became absolutely firmer, and thus capable of making a greater resistance to the impetus of the blood. The experiments of Hunter, therefore, may be adduced as examples of the powers the system possesses for repairing an injured artery; while those of Haller show that the internal membrane of the artery is not alone sufficient to resist the impetuosity of the circulation, and hence, when the two external tunics of an artery are ruptured or destroyed by disease, an aneurismal tumour may be formed by the distension of the internal coat alone.

Experiments have also shown that the force of the blood's current is not sufficient to dilate the external coat of an artery when the fibrous and inner coats have been ruptured by temporarily tying a ligature tightly round the vessel. In place of the external cellular tunic giving way, and forming an aneurismal tumour, the powers of nature are exercised here as after wounds, in restoring the injured parts by the effusion of coagulable lymph, and this happens in some instances to such a degree as to obstruct the flow of the blood, and entirely interrupt the circulation through the artery.

Whilst artificial means of producing an aneurism by destroying the external or cellular coat of arteries in a living animal have failed, experiments have shown how readily in the *dead body* an aneurism or bulging of the cellular coat can be produced by forcibly injecting either air or water into an artery, when the internal and fibrous coats have been previously divided. By injecting water into the pulmonary artery with such a degree of force as to rupture the internal and middle coats, Nicholls found that the external coat became distended. Having divided the internal and middle coats of different arteries by the application of ligatures, Hodgson also found that, by forcibly inflating the vessel, "the external tunic always exhibited a sufficient degree of dilatation to prove that it is more liable to yield and to be expanded into a sac, than to be ruptured by the impulse of the blood." But the same experiment in a living animal produced a very different result; and Jones proved that the laceration of the internal and middle coats of a healthy artery was not followed by a dilatation of the cellular coat, or by the formation of an aneurism, but that fibrine was effused on the injured surfaces which, in place of enfeebling, rendered the parietes of the artery firmer at that point. It must, however, be very different when the coats of an artery which are in a diseased state give way, for then the restorative powers of nature are not sufficient to strengthen the lacerated coats, and the force of the blood's circulation becomes sufficient to distend the cellular coat and to form an aneurismal pouch. We would not, however, be understood to offer this as a perfect explanation of the etiology of aneurisms in general. Other influences, doubtless, may have a share in their development, and we by no means contest the point; on the contrary, we admit that there is still a good deal of obscurity in the history both of the predisposing and proximate causes of this affection. All we mean to say is, that the impossibility of producing aneurism by experiment on healthy arteries, does not invalidate the influence in its production of those organic alterations of the arterial tunics.

Aneurisms are observed to form most frequently in certain arteries, and in particular parts of them. The arterial trunks of the first magnitude become aneurismal much more frequently than those of inferior calibre, and hence internal are much more frequent than external aneurisms. Aneurisms are most frequently formed at the curvature of these arteries, and where they divide into branches. The aorta, particularly at its arch, is more frequently affected with aneurism than any of its branches; and this observation accords with the theory, that the lateral impulsion of the blood concurs in the production of aneurism when the structure of the artery has undergone a change: the curves formed by the arteries being precisely the points where this impulsion is greatest, and where aneurism occurs most commonly. The innominata, subclavian, carotid, axillary, iliac, and femoral arteries, are subject to aneurism next in frequency, whilst the temporal and occipital arteries, those of the leg, foot, and forearm, and the arteries within the cranium, are rarely found to be aneurismal. The peculiarity in the structure of the arteries within the brain is one reason why a destruction of their coats is much more frequently followed by an extravasation of blood than by the formation of an aneurism. It sometimes happens that an aneurism is formed at the point where a branch is sent off from the arterial trunk. When this takes place, the branch, if they should be but one, is sooner or later detached from the parent trunk by the progress of the tumour, which is as it were interposed between them. The mechanism of this transportation is thus explained by Berard (Archives Gén. de Méd., July 1830:) the internal and middle tunics having yielded around the origin of the vessel, it is now connected with the trunk through the cellular tunic only, and in proportion as the sac becomes distended, the branch becomes the more distant from the artery which gave it origin. The arterial branches which are thus detached, are usually found to be obliterated at their point of communication with the sac, having undergone adhesion by effusion of plastic lymph from the internal surface of the cellular tunic, or being plugged with coagulum, which has formed in consequence of the languid state of the circulation in those branches; but this occlusion of the vessel seldom extends beyond the next collateral, so that the circulation, so far from being cut off by the adhesion or plugging of the transported orifice, is on the contrary rendered more vigorous by the dilatation which is thus produced in the anastomosing branches, while it favours, at the same time, the coagulation of the blood in the aneurismal sac itself.

Effects of an Aneurism on the surrounding Structures.—There is a tendency in the living fibre, to whatever class it may belong, to degenerate when condemned to perfect repose. In the case of an increasing aneurismal tumour, this cause of degradation is promoted by the pressure which the tumour itself produces on the surrounding parts. But this is not all; organs are displaced, blood-vessels are obliterated, nerves are stretched, muscles are distended and atrophied, and even the bones and cartilages are altered and destroyed. It must be obvious therefore, that when such a variety of structures is successively involved in the progress of an aneurism, that the symptoms which accompany its development will have relation to the nature and functions of these several tissues: thus when the muscles are compressed, elongated, or disturbed from their natural situation, their movements are impeded, perverted, or abolished; when the nerves are subjected to the same influences, the most intolerable pain is produced, and continues until they are wasted and disorganized, and then the pain gives place to numbness, which prevails throughout the whole limb; when the veins and lymphatics are acted on in the same way, some become obliterated while others are dilated, the limb feels cold, and is more or less œdematous; even the bones themselves are destroyed by the pressure and pulsation of an aneurismal tumour. This destruction, however, has no affinity to either caries or necrosis; the bone softens, and is then absorbed irregularly, but it neither suppurates nor dies, and this is a circumstance of some importance as regards the treatment that may be adopted, for if the progress of the tumour can be arrested by the ligature, the condition of the bone will not contra-indicate its application, as it must do, had the bone been affected with caries. This, however, is so far from being the case, that the portion of bone that has been spared is often found to be extremely hard. The cellular tissue disappears altogether, or is so wasted and thinned as to be undistinguishable from the sac of the aneurism itself; and the same may be said of all the other soft tissues, when the tumour is allowed to proceed unchecked, until it has no other covering than the common integument.

Number of Aneurisms.—Though it seldom happens that there is more than one aneurism in any individual, there are cases where many aneurismal tumours have been found after death. Dessault saw a man who had six aneurisms, and Delpech found no less than sixty in one individual. Such cases, however, are extremely rare, and though almost in every aneurismal patient many portions of different arterial trunks are usually found diseased, yet it seldom happens that the tunics have given way so as to form an aneurism at more than one place.

Fig. 61.

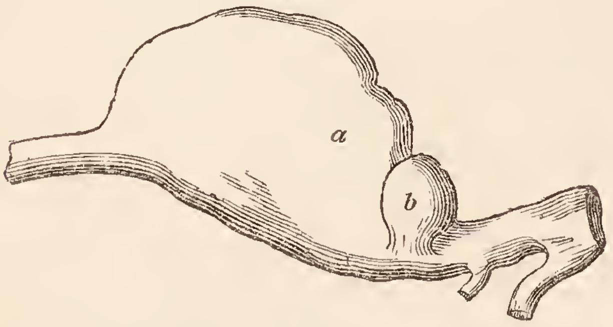

Fig. 61 *is an outline of a large aneurism of the axillary artery* (*a*), *immediately contiguous to which, and on its cardiac side there is a smaller swelling* (*b*), *which not being recognised before an attempt was made to pass a ligature round the artery, was the the cause of the impracticability and danger of the operation.*

Progress.—In this respect there is great variety, not only as to the duration of the disease, but also as to the condition of the tumour itself. The progress of an aneurismal tumour is hastened or retarded by a great number of circumstances, and may therefore occupy many months, or even years. As regards the condition of the tumour, it may retain an uniform spherical appearance to the last, or, as it advances, it may become irregular, knobbed, and appear to be made up of several tumours formed in succession, according to the various degrees of resistance the different parts of its surface may have to encounter.

Dehaen states, that he had seen a case of aneurism which had been progressing for a number of years; while Hodgson, on the other hand, describes a case in which the disease ran through all its stages with extraordinary rapidity.—" An old man, who uniformly enjoyed good health, whilst walking in the street, was attacked with a sudden pain, and immediately perceived a small swelling in the middle of the right thigh. The pain increased, the swelling became larger, and in a few hours the whole limb was œdematous. The tumour was compressible, but no pulsation could be discovered in it until a short time before death, when an indistinct thrill was perceptible. He became extremely feeble, the swelling increased, and he died in three weeks from its first appearance. A quantity of grumous blood was found amongst the muscles of the thigh, which were separated to a considerable extent, so as to form a large cavity on the anterior surface of the triceps. The femoral artery communicated with this sac by a small round opening not larger than the calibre of the vessel. This opening was evidently the mouth of a small aneurismal sac, which had suddenly burst, and given rise to the diffused extravasation, for the dilated and ruptured coats of the vessel were seen at the bottom of the cavity, reflected upon the external surface of the artery. The original sac could not have been larger than a pea, and was formed by a partial dilatation of the coats of the vessel, which were throughout much thickened, and covered with calcareous matter [1]."

Sex.—Aneurisms are much more frequently met with in men than in women, for whilst the sedentary habits of the female render her frame more particularly subject to certain diseases, aneurism, being usually caused by some violent muscular exertion, might be anticipated to befall men much more frequently, not only from their avocations, but also from the circumstance that the arterial system is in them much more liable to disease.

Age.—Patients most usually affected with aneurisms are neither the very young, nor those far advanced in life. Those diseased states of the tunics of an artery which lead to the formation of an aneurism, are not often met with in young people; whilst the aged are seldom exposed to those great muscular exertions which by causing the coats of a diseased vessel to give way, lead immediately to the formation of an aneurism.

Diagnosis.—In the early stage of an external aneurism, its true nature is easily detected, but in a more advanced state, when it has attained a considerable magnitude, when the pulsations have become more indistinct, and when pressure produces no perceptible change in its volume, it is then often no easy matter to form a correct diagnosis. Under these circumstances, the history of the case must be the chief guide in ascertaining its nature. If the origin and progress of the disease have been such as in those cases we have already described as characteristic of aneurism, an opinion can then be formed with confidence. But it seldom happens that an account sufficiently clear can be obtained from the patient, to leave no doubt as to the true nature of the disease, and the difficulty is much increased when the tumour itself does not present any of the pathognomonic symptoms of aneurism. Thus, an aneurism has frequently been mistaken for an abscess, been laid open, and a fatal hæmorrhage has followed. Old aneurisms, too, have often been mistaken for swellings of a quite different nature, and tumours situated in the vicinity of large arteries which had the pulsations of the contiguous arteries communicated to them, have also been mistaken for aneurisms. An aneurism, however, may be distinguished from a tumour which is situated on the course of an artery by the history of the disease, and likewise by the character of the pulsations. Whilst an aneurism commences as a soft tumour, which disappears when subjected to pressure, most other tumours are, on their first appearance, of firmer consistence, and pressure produces no diminution in their size. An aneurism, as it increases in bulk, increases also in density, and the increase in its firmness commences at the circumference of the tumour and gradually extends towards the centre. In a tumour which has become soft by the process of suppuration, the fluctuation is on the contrary, first perceived in the centre, and gradually extends to the circumference of the swelling, and, therefore, the longer the tumour has existed, the softer will it generally be. The pulsations of an aneurism cannot be changed by any alterations in the position of the affected limb, but those of a tumour situated on the course of an artery will be altered by a change in the position of the limb, the tumour being displaced, the pulsations of the artery cease to be communicated to it; or a tumour may be distinguished from an aneurism by elevating the swelling from the artery from which it derives its pulsations.

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[1] Hodgson, p. 71.

The smaller the tumour and the more recent its formation, the more distinct will be the pulsations of an aneurism; but the pulsations of other swellings are more evident in proportion to their size, owing to the greater degree of pressure which they exert on the subjacent vessels.

Before much coagulum is deposited within the sac, in an aneurism, the pulsation is felt equally throughout the whole circumference of the tumour; and as it increases in size, and the coagulum becomes deposited in greater quantity in the sac, the pulsation will be felt only at the centre of the swelling; in a still more advanced state of the disease, when there is a thick coagulum deposited, the pulsations are obscure or not at all perceptible. The movement discernible in a tumour placed on the course of an artery is not that effort of dilatation which an aneurism presents, but a lifting or displacing of the whole mass of the swelling.

When collections of purulent matter form in the vicinity of an artery, the vessel communicates a motion to the fluid in the tumour similar to that of an aneurism; and the diagnosis is rendered very difficult, if there have not been symptoms which would lead to suspect the formation of pus.

In order to distinguish between an aneurism and an abscess formed in the course of an artery, we must remember that the latter is preceded by certain local and general symptoms, more or less evident, such as inflammation, rigor, &c., that the tumour, when pressed upon, remains unchanged as to bulk, and that it is elastic. In the case of a cyst, the mistake is less likely to be made; for though in aneurismal tumours of long standing, the circumference feels hard, owing to the laminated deposits of fibrine, still its centre will afford signs of fluidity, and its size will be increased or diminished according as pressure is made either on its cardiac or capillary side. It also sometimes happens that an aneurismal tumour in its progress to the surface, gives rise to inflammation of the cellular tissue, and the formation of an abscess: here the purulent collection masks the more serious affection, and an error of diagnosis may be easily committed. In such cases, whether the pus be evacuated or not, the progress of the aneurismal tumour becomes very rapid, and prompt measures must be resorted to, in order to save the patient from the hæmorrhage, which is imminent. The diagnostic, as in the former instance, can only be guarded by referring to the history of the case.

When, notwithstanding our best endeavours, we are not fortunate enough to remove all doubts, and more especially if the tumour has been stationary for some time, it will be best to abstain from any interference with it; time, and repeated examinations in every variety of posture, will often dispel the obscurity. But if, on the other hand, the tumour continue to make such progress that, if left to itself, it must soon be beyond the reach of art, the pain becoming intolerable, and the limb œdematous; in a word, if more serious mischief threatens to result from our leaving the tumour to itself, than can follow from an attempt to clear up the diagnosis, then it will be justifiable to make an exploratory puncture with a needle, or small trocar. The surgeon will have only to act according to the indication he obtains. Should it be arterial blood, the case becomes clear. The small puncture will not give rise to hæmorrhage, if it be firmly covered with adhesive plaster. But after this, delay would not only be improper, but dangerous. He must concert the measures to be taken, and carry them into effect, after as brief a period of preparation as the circumstances of the case may require.

The advantage in an obscure case of repeated examinations of the tumour after intervals of several days is this, that the pulsation may be present at one time, and absent at another, a circumstance which is easily explained: the pulsation is strong when the communication between the artery and the sac is free; but if the opening be small, and blocked up by a coagulum, the thrill will be obscure, and often imperceptible, until the coagulum becomes displaced.

When all the signs of an aneurism are equivocal, the stethoscope may be of use, and will often enable us, even in advanced cases, to detect the bellows', or rasp sound, produced by the entrance and exit of the blood in the tumour at each contraction of the heart.

There can be no more convincing proof of the difficulty of forming a diagnosis of aneurism, than the fact that in some cases very contradictory opinions have been given by eminent practitioners. A female had a tumour about the bulk of a hen's egg, which formed in the site of the subclavian artery; and such was the difficulty in ascertaining its true nature, that one surgeon was of opinion it was an aneurism; another thought it was a glandular swelling; a third suspected it to be an aneurism, and a fourth would not give a decided opinion. The patient followed Valsalva's system of treatment, and got well, though no circumstance subsequently occurred by which the precise nature of the tumour could be distinguished.

The signs presented by an aneurism situated within any of the great cavities, are generally very obscure, until it has attained a considerable size, and then the symptoms depend on the effects of the compression of the tumour on the surrounding organs. Thus, an aneurism within the cranium will cause a disturbance in the function of the brain; or within the chest, will influence the respiratory organs; and in the abdomen it will produce more or less derangement of the digestive apparatus.

The indistinct pulsation which may be detected in the thorax and abdomen may be referred to other causes. In the thorax it may arise from an affection of the heart, and in the abdomen from a derangement in the digestive apparatus, causing an increase in the circulation. Thus the diagnosis of aneurism within the great cavities is very obscure, whilst they remain within those cavities; but when they have made such progress as to appear externally, after destroying the soft parietes of those cavities, or the bones which oppose their developement, then their true nature is no longer concealed.

A true aneurism has often been confounded with the *dilatation of a vessel*, and it is of importance to distinguish these two very different conditions of an artery, not only because their anatomical characters are essentially different, but the mode of treatment applicable to the one disease is not necessary for the other.

When an artery is preternaturally *dilated* the enlargement is not limited, as in aneurism, to a particular portion of the vessel, but its whole circumference is augmented, though not to an equal degree in every part; and in place of the tunics of the artery being thickened, they are thinner than natural—each of of them is equally dilated, and there is no coagulable lymph or fibrine effused on their internal surface. The portion of the artery thus dilated has indeed more the appearance of a vein than of an artery—particularly a portion of vein which has been repeatedly punctured in the operation of phlebotomy, the coats being condensed and assimilated together in such a manner, as to render them not easily separable from one another. The circumstance of a dilated artery not being lined with a fibrinous concretion forms a striking difference between this pathological condition of an artery and a true aneurism; for whilst the sac of an aneurism is protected, and its rupture prevented, by the additional thickness which it receives from the effusion of fibrine, the circumstance of the economy not having recourse to the same means of protection in cases of simple dilatation, ought to be considered as an incontrovertible proof of an essential difference in the condition of an *aneurismal* artery from that of a vessel wherein there is simply dilatation.

Dilatation is most frequently observed in the aorta, but it is usually accompanied in that vessel by a diseased state of the coats, similar to that which precedes or accompanies aneurismal swellings; but the simple dilatation of an artery happens, I believe, most frequently in the innominata, subclavian, and carotid arteries, and it usually takes place where the vessels divide. In these arteries, the dilatation is apt to be mistaken for aneurism—a mistake which I have known to be made, and which I have myself once committed. The dilatation of an artery can, however, be readily distinguished from an external aneurism, from the great thinness of the parietes of the whole tumour, compared with that of an aneurism, from its form being more elliptical than globular, from its slow growth and often stationary character, and also from its never bursting or acquiring the volume of an aneurism. It ought also to be observed, that the two diseases, dilatation and aneurism, may both exist at the same time, and that the coats of a dilated artery may give way and form an aneurism, as has been stated in another place.

Fig. 62.

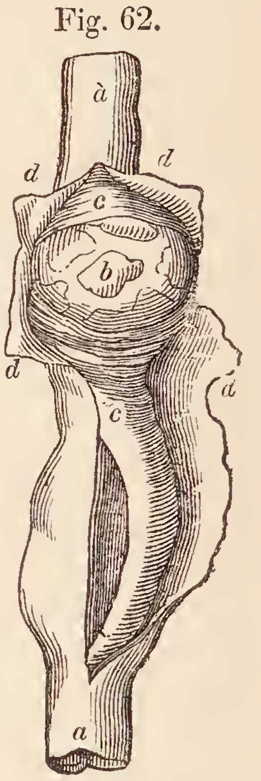

Fig. 62 *represents a portion of the femoral artery dilated, in which is also two aneurismal swellings.* (*a a*) *is the arterial tube;* (*b*) *is the internal membrane of the vessel dilated, separating and progressing through amongst the fibres of the middle coat;* (*e e*) *the circular fibres of the middle coat, some of which are separated so as to permit the internal coat to form a sort of hernia;* (*d,d,d,*) *different portions of cellular coat divided to show the internal structures,* (*Breschet*).

Prognosis.—Aneurism, in whatever part of the arterial system it may occur, always constitutes a disease of a serious character, the degree of danger depending on the size of the affected vessel, the state of the arterial system generally, the manner in which it appears to have been produced, the part of the body in which the diseased vessel is situated, and the age and general health of the individual. If the formation of the tumour cannot be attributed to any injury or severe bodily exertion, but has come forward in a very gradual manner, the danger is greatest; for then, in all probability, the aneurism is connected with a more extensive affection, not only of the aneurismal artery, but perhaps of the whole arterial system. It was remarked, when speaking of the condition of an artery where an aneurismal tumour existed, that the coats of the vessel were almost in every case diseased previously to the formation of the aneurismal tumour; it will, therefore, sometimes happen that the disease of the coats will also exist at the very point where the ligature is about to be applied for the cure of the disease, and hence one cause of many of those fatal hæmorrhages which have taken place after operations of aneurism. If the aneurism occurs in a healthy constitution, in a part of the body within reach of surgical treatment, and has been caused by an injury, the case is not of so grave a nature. But experience has shown that even the existence of more than one aneurism, in an external situation, does not present an insurmountable obstacle to the successful treatment of the disease. Two aneurisms in the same person have been in several cases cured by the applications of ligatures on the femoral arteries.

Home tied both the femoral arteries in the same person for popliteal aneurisms in both limbs: the interval between both operations being only five weeks. Freer also operated in a similar case. Valentine Mott, of New York, treated a third case after the same manner, the interval between the two applications of the ligature being only fourteen days. The result, in all these cases, was successful. But the aneurismal tumours were all external. As regards the nature of the prognosis, a distinction is made, and very properly, if one of the tumours happen to be internal. In such a case, if a ligature be placed on the artery for the cure of the external aneurism, it will have the effect of accelerating the progress of the internal one, and the operation therefore would be not only useless, but mischievous.

In general, when the affection is of long standing, and has involved the surrounding parts to a considerable extent, the collateral vessels are often so extensively obliterated, as to be insufficient for nourishing the limb. An aneurismal tumour that has attained an enormous bulk, may already have produced alterations of so serious a nature in the muscles, nerves, articulations, and even in the bones, that a favourable prognosis, as regards the cure by ligature at least, cannot be entertained. In such cases, amputation only can save the patient. When gangrene attacks an aneurismal tumour, the danger is imminent; but even in such cases, the ligature may still be applied. Sir A. Cooper tied the external iliac artery in two cases of inguinal aneurism in which gangrene had already commenced. The tumours suppurated kindly, and the sacs becoming covered with granulations gradually cicatrized.

In aneurisms, as in all other affections of a serious nature that require operations, the general state of the patient must be taken into account, for the gravity of the case may often depend more on this, than on the local disease. In a scorbutic, syphilitic, or gouty diathesis, the prognosis cannot be otherwise than unfavourable.

TREATMENT.

From the dangerous nature of aneurism, its treatment has necessarily engaged much attention, and it will be found that the different therapeutic means which have been successfully employed for the cure of this disease have all been in strict imitation of those spontaneous curative processes which have already been described. As the spontaneous cure of an aneurism is effected by laminæ of concreted fibrine lining, and even completely filling up, the sac, thus enabling it to resist that impetus of the blood which causes the enlargement or rupture of an aneurismal tumour, and as the formation of a fibrinous concretion, or the process of coagulation, as it has been usually denominated, proceeds more or less quickly, according to the force of the circulation of the blood in the tumour, any endeavour to cure the disease must be conducted with a view either to diminish or entirely arrest the circulation of the blood within the sac. Two principles of treatment have, therefore, been held in view for the cure of aneurism; the one having for its object to diminish the force of the circulation, and the other completely to prevent the circulation of the blood in the tumour. The first of these is effected by lessening the vigour of the action of the heart, and diminishing the quantity of the general mass of blood; whilst the second is to produce a mechanical hinderance to the flow of blood within the sac.

Valsalva's method.—For the treatment of aneurism according to the first mode, the system generally employed has been that which was originally proposed by Valsalva, and which many others since his time have successfully adopted. Valsalva conceived that a radical cure of aneurism might be accomplished by reducing the force of the circulation to a degree compatible merely with the continuance of life, and this he effected by repeated abstractions of blood, first in large, and then in small quantities,—by limiting the quantity of food and drink, and likewise preventing, as much as possible, any inordinate action of the heart, by keeping the patient constantly in a supine posture, and avoiding all mental excitement. This system of treatment was carried by Valsalva to such an extent that, "ultimately the patient was only allowed half a pint of soup in the morning, and a quarter of a pint in the evening, and a very small quantity of medicated water. When so reduced that he could not raise himself in bed, the quantity of nourishment was again gradually increased, until his strength was restored."

Experience amply proved the efficacy of Valsalva's system of treatment, and there is the testimony of many eminent men of the progress of numerous aneurismal tumours having been arrested, and others completely cured, by this depletive system.

It happens, however, that this plan of treating aneurism, as recommended by Valsalva, is not very generally adopted, more particularly in this country, and this may arise partly from the important advancement which has of late years been made in the surgical treatment of external aneurisms, and also from the opinion generally promulgated, that by debilitating a patient by a long-continued depletive system, although the impetus of the blood's current will be diminished, yet the change produced in the chemical qualities of the sanguineous fluid will be the means of impeding, instead of promoting that very process of coagulation which it is the primary object of the treatment to fulfil. "It ought to be admitted," observes Velpeau, "that it is difficult to comprehend how the treatment of Valsalva is efficacious. Without doubt, by blood-letting frequently repeated, and a rigorous diet, we are able to reduce the force of the heart and the pulsations of an aneurismal tumour. The volume of such a tumour may be diminished in the greater number of cases, but is it not to be feared that by enfeebling a patient we shall increase the fluidity of the blood; and that far from favouring its concretion, the consolidation of the aneurism and the obliteration of the artery, we, on the contrary, render all these different phenomena more difficult?"

In proof, however, of the soundness of the practice of Valsalva, and of the erroneous theory of its *rationale*, the researches of modern physiologists on the properties of the blood afford most satisfactory evidence; for whilst it has long been well known that in proportion as an animal is depleted, so does the quantity of the fibrine become *diminished*, it is a curious and no less important fact, "that fibrine coagulates the more speedily in proportion as the circulating and nervous systems *become more feeble*." The experiment has been repeatedly made with animals by bleeding them to death, the last portion of blood being found invariably to coagulate the soonest, and, as has been justly observed, "the principle of the blood's concretion being in the ratio of the debility of the animal from which it is withdrawn, is one of those wise provisions of which we see numerous examples in the living body[1]."

This important discovery of the property of the fibrine of the blood to coagulate more and more speedily in proportion as the person has been depleted, explains how, by the more ready coagulation of the fibrine, when life has been nearly extinguished, the divided vessels are speedily sealed up, and the bleeding arrested. In like manner, we can satisfactorily account for the successful practice of Hippocrates, who, in hæmorrhage from the lungs, employed blood-letting along with the antiphlogistic regimen, so far as to exsanguinate the patient and produce excessive debility.

For establishing the plan of treatment of aneurism proposed by Valsalva, we therefore have not only the practical result of such a system, but physiological science enables us to give a most satisfactory explanation of its *modus operandi*, and one important inference we are entitled to draw is, that not only ought this mode of treatment to be adopted in internal aneurisms, or those beyond the reach of the surgeon, but that it may be advantageously resorted to in cases wherein an operation may be ultimately advisable, because such treatment will not only greatly ensure the success of an operation, by tranquillizing the action of the heart and arteries, but will render the system less liable to inflammation, and may be the means of checking the progress of that disease in the coats of an artery which leads to the formation of aneurism and favours its future growth.

Besides the means recommended by Valsalva, there are additional measures which ought to be employed in the medical treatment of aneurism, and it is important to bear in mind, that even when all these means combined fail in curing, or in arresting the progress of the tumour, the patient is in a position wherein a surgical operation would be undertaken with a better chance of success than if such previous system of treatment had not been adopted. Of these means, the most important is the exhibition of those remedies which are known to have a specific effect in diminishing the action of the heart and arteries. In the use of *antimony* I have the greatest confidence, and have found the James's powder superior to all the other preparations of that mineral. From three to six grains of this powder may be given every six, eight, or twelve, or twenty-four hours, either singly or combined, with one grain of the extract of rhubarb or aloes. The frequency of the dose may be diminished when nausea is produced; and the aloes or rhubarb may be omitted should they act too frequently on the bowels.

When the tartrate of antimony is to be administered, the third or fourth of a grain may be given two or three times a-day, either in solution, or made into a pill with rhubarb, aloes, or gentian. In either of these forms, antimony may be taken for a lengthened period, and it ought to be administered as long as it appears to have a decided influence on the organs of the circulation, in conjunction with the other means, which are at the same time adopted to diminish the bulk and increase the thickness of the parietes of the aneurismal tumour.

Local remedies, along with the depletive system of Valsalva, and the use of those remedies which tranquillize the circulation, also assist in checking the progress, if they do not effect the cure, of an aneurism. Of these, I may first mention the local abstraction of blood by the application of *leeches*, the number of which ought to be few, but their application should be repeated every day or every second or third day, according to the relief which they afford. This practice is particularly applicable to internal aneurisms; and I have, in many instances, considered it to be the means of relieving congestion, more particularly when the aneurism has been seated in the thoracic cavity, and of diminishing the vascularity of the aneurismal sac and adjacent soft parts, to a greater degree than could be accomplished by general blood-letting.

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[1] Thackrah.

Astringents and refrigerants have, along with the application of leeches, a decided influence in abating the local inflammatory symptoms, and likewise in diminishing the congestion of blood in the sac. Of these astringent remedies, there is no one more serviceable than the acetate of ammonia, or the superacetate of lead, diluted with rose or camphorated water. Diluted spirits and vinegar have also been employed for similar purposes, and the choice of these applications should be made according to their effects on the individual case, that being preferable which gives ease, and is most comfortable to the patient; and the best mode of using them, is by covering the tumour with a piece of lint which is kept moist during two or three hours, three or four times a-day.

In some cases *ice* may be employed with advantage, and is to be applied within a bladder after being sufficiently comminuted. Its use, however, requires great caution, and its application should not be continued when it creates pain or uneasiness.

Chemical agents.—It has been attempted, by Sir Everard Home, to cure an aneurism by causing the coagulation of the fluid blood within the sac by the application of heat.

" In a case of aneurism in the external iliac artery, in Chelsea Hospital, for the cure of which I tied the femoral artery *below* the sac, on the 16th September, 1825; finding that this operation neither diminished the pulsation, nor arrested the increase of the size of the tumour, I was led to introduce an acupuncture needle into the centre of the tumour, where the pulsation was most violent, and the fluid state of the blood most distinctly felt: the needle was passed through a small orifice in a bar of steel three inches long, the skin of the thigh was protected by cork, and the needle was heated through the medium of the steel by a spirit-lamp. In a few minutes the patient felt heat and pain in the centre of the tumour, but not very severe, so that the application was continued for fifteen minutes, during which the pulsation in the tumour was diminished; on withdrawing the needle, the orifice was marked by a single drop of coloured serum. In half an hour, intense pain was felt in the thigh; but this was not only removed in ten minutes by twenty drops of laudanum, but the thigh and leg became more easy than they had been for the previous twelve hours, and the throbbing in the sac was reduced to an undulation.

" This application of heat was not resorted to till the twenty-eighth day after tying the femoral artery, during which time the swelling had increased considerably in size. The man was forty-three years of age, had served eighteen years in the fourteenth dragoon guards, and was a hard drinker. For two days the tumour was easy, and the pulsation had become less under the punctured part than higher up towards the belly. The tumour not diminishing, the operation was repeated on the thirty-fourth day from tying the artery; the needle and bar of steel double the size of those before used, and the application continued thirty-five minutes. The internal heat was greater than before, and the pulsation in the tumour much diminished. The needle was with difficulty withdrawn; a coagulum as hard as sealing wax, the size of a pin's head, being firmly attached to the middle of the needle. The pain the operation produced subsided in ten minutes; the internal heat continued twenty-four hours, and the tumour had now a solid feel: he was quite easy for two days, but on the third the pain and pulsation returned; also the inward pain in a still greater degree than while the needle was immersed, and the tumour was extremely tense. Under these circumstances, on the forty-fourth day after tying the femoral artery, I repeated the application of the acupuncture needle and steel double the size of those last employed: the heat felt internally was very great, but the pain was not much increased; after it had been immersed twenty minutes, the pulsation all at once stopped, and the needle was immediately withdrawn; the pain in ten minutes went off, and the patient was quite easy. From this time there was no pulsation in the tumour, which to the feel appeared solid, and therefore I considered the progress of the aneurism arrested; this was in some measure proved by the pulsation remaining violent in the external iliac artery down to the part pressed upon by the sac, but no further.

" Although the patient was free from pain, took his usual allowance of food, and relished his wine and porter as much as before, the foot, about the fiftieth day became cold to the touch, the thigh and the leg œdematous, and about the sixtieth day vesications made their appearance on the foot and leg; the skin lost its sensibility, and although he had little or no pain, the weight of the thigh took from him all power of moving it.

" These symptoms were the forerunners of mortification; the pressure from the tumour above preventing the leg from receiving a sufficient supply of nourishment; they did not, however, increase, and he remained in nearly the same state till the ninetieth day, when he died.

" The upper part of the thigh, which had been regularly measured, was found, on the forty-fourth day, to be twenty-four inches, and remained of the same size at his death—three inches and a-half beyond that of the other.

" On the examination of the parts after death, the external iliac artery was found to pass down in the front of the aneurismal sac; it was pervious in its course to the part where the ligature had been made on the femoral trunk; there it was plugged up by a small coagulum, beyond which it was impervious. The opening into the sac was on the posterior part, and was one inch in length. The upper portion of the sac occupied a part of the cavity of the pelvis, and by its pressure prevented the branches of the internal iliac artery from supplying the thigh with blood."

"The coagulum in contact with the sac was the same as is usually met with in large aneurismal tumours; with that, there were innumerable thin, firm laminæ, and the innermost portion was in the state of jelly.

"It is a circumstance which could not have been foreseen, but one highly satisfactory to myself, that had I attempted to tie the artery *above* the formation of the aneurismal sac, I must have failed, since the sac extended higher than the division of the iliac artery into the external and internal, so that the external branch could not have been secured without wounding the sac, which would have proved fatal; and in the space above, between the division into the two iliacs, and the bifurcation of the aorta, there was an ossification an inch long; so that if the artery had been secured there, when the ligature separated, the patient must have bled to death. It may be said, that I might have taken up the aorta above the bifurcation; but I have made up my mind to let those diseases that require tying the aorta, which come under my care, take their course[1]."

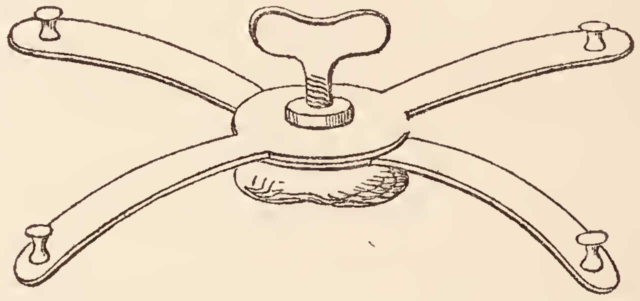
This new and ingenious mode of treating aneurism, by causing the coagulation of the fluid blood contained within the sac, and which was first suggested by Monteggia, of Milan, may be ultimately found of the highest practical importance, and may perhaps lead to the discovery of some safe as well as effectual means of obliterating an aneurismal sac—more easily than by the application of heat, or by any of those surgical proceedings which are usually resorted to for the cure of this formidable disease. It appears to me that the fluid blood contained within an aneurism might be coagulated with safety, by injecting into the sac a proper quantity of one of those substances which produce the instantaneous coagulation of blood that has been just removed from a living animal. Of these substances, perhaps there is no one which would be better adapted for this purpose than *acetic acid*, a small quantity of which is known to coagulate a very considerable quantity of blood. Vinegar could be very easily injected into the sac of an aneurism with Anel's syringe, a puncture having been previously made into the sac with a needle; and it might be advisable to arrest the circulation through the diseased artery, previously to such an operation, by an adequate compression of the vessel either on the capillary or cardiac side of the tumour. If the blood within an aneurismal sac could be thus coagulated, its curative effects might be reasonably supposed to proceed in the same manner, as if the coagulation of the blood had been effected by obstructing the circulation through the vessel by the application of a ligature.

It has also been proposed to coagulate the blood within an aneurism, by conducting a galvanic stream along needles introduced into the sac. (*Phillips*, *Pravaz.*)

Compression.—When local and general means have failed, or when from any cause they have been found inapplicable to the treatment of an aneurism, the next resource of art is to effect the consolidation of the tumour by the application of pressure, or by placing a ligature on the diseased vessel. The records of surgery afford many proofs of external aneurisms having been cured by compression, and the compression has been applied either on the tumour itself,—upon the diseased vessel on the cardiac,—or on the capillary side of the tumour, or on the whole of the limb wherein the aneurism is situated.

Various contrivances have been made use of in order to produce the necessary degree of pressure on an aneurismal tumour, but the objection to most of them is the great pain which their long-continued pressure creates. The instrument of *Seunfio* has been that most usually employed.

Fig. 63.



The instrument, represented in fig. 63, *consists of two metal plates which cross one another and form four separate branches, at the extremity of each of them is to be affixed a belt which is to be passed round the limb. Through the central plate a screw passes, to which is attached a pad; so that by turning the screw any degree of pressure can be made, the pad having been placed immediately above the artery.*

Compression, under favourable circumstances, and when properly made, may be highly useful; for even should it fail in such instances, it will not only not have been in any way injurious, but it will have had such an effect on the collateral circulation as to render the success of the ligature more certain.

In selecting the point on which compression may be made, regard should be had to the points where the artery is most superficial, as well as where it may be pressed against a bone. Compression may be made on the axillary artery, behind the clavicle—on the femoral, where it passes over the pubis, or at the upper and inner part of the thigh,—on the brachial, against the humerus, &c.

In some persons, the effects of the pressure are such as to render perseverance in its use either impossible from the pain, numbness of the limb, and excoriations, &c., or unadvisable from the œdema which it may determine.

After a bandage has been applied moderately tight from one extremity of the limb to the other, a compress may then be placed upon the tumour, and with a common tourniquet surrounding the limb, any degree of pressure may be applied on the compress, the whole limb having been previously secured from the action of the instrument by a piece of board wider than the limb itself, placed on the opposite side to the tourniquet,—by which means the tumour alone will be compressed. (*Freer.*)

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[1] On the Coagulation by Heat of the Fluid in an Aneurismal Tumour.—*Phil. Trans.* 1826.

The compressor of Dupuytren, which is usually employed in France, consists of a semicircle of solid steel, having at one extremity a large concave cushion adapted to the posterior part of the limb opposite to the diseased artery, and at the other extremity there is a pad which can be brought near to the cushion or removed from it by means of a spiral spring and screw. The pad is to be applied upon the artery, so that by turning the screw the requisite degree of pressure is made, and is confined to the two opposing points of the limb on which the cushion or pad is placed. When the screw is tightened, the instrument may be employed either for making the necessary degree of compression on the tumour, or on the artery above, or below the aneurism, as may be deemed most advisable.

An easy mode of applying compression upon an aneurismal tumour may be accomplished, by spreading a layer of plaster of Paris on the surface of the tumour upon which a moderate degree of pressure is to be afterwards made with a bandage. Besides the pressure effected by the bandage, there is a certain degree of compression produced by the contraction which takes place in plaster of Paris during its consolidation: at intervals of a few days the plaster should be removed and a new coating applied. By this means, Mr. Bennett Lucas cured a popliteal aneurism, without causing the degree of pain which usually is created by the other modes of applying pressure.

Compression on the *capillary* side of the tumour has also been proposed, and the plan was once adopted in a case of inguinal aneurism, but the force of the pulsations in the tumour were increased to such a degree as to render this mode of treatment inadmissible. (*Vernet.*)

The most common mode of using pressure for the cure of an external aneurism is by the compression of the whole limb, and it is of importance to bear in mind that pressure thus employed, whilst it diminishes the momentum of the blood in the diseased artery, must not be carried to such a degree as to interrupt the circulation in the other arteries of the limb, or that of the veins and absorbents; and above all, in the nerves. Any undue pressure upon the arteries will be the means of preventing a sufficient quantity of arterial blood being circulated for the nourishment of the limb, and if the absorbents be compressed, and the venous circulation interrupted, the limb will become œdematous; and if pressure be made upon any of the nervous trunks, the pain will be so great as to render a continuance of the practice inadmissible. This general compression of the limb is best effected by applying a roller firmly, but not tightly, commencing at the extremities of the toes and fingers, and extending it above the aneurismal tumour. But, before the compression is applied to the tumour a compress ought to be placed, not only upon the aneurism, but over the trajet of the diseased artery on its capillary side. The bandages may be kept moistened with astringent lotions, and the curative effects of this compression are to be assisted by the complete rest of the limb, the evacuating treatment, the horizontal posture, and all such means as diminish the force of the blood's circulation.

Compression, in whatever mode it may have been successfully applied, has been supposed to cure an aneurismal tumour when small and of recent formation, by causing the sides of the artery to come in contact, and thus obliterating the tumour; whereas, when an aneurism is of a large size, and of long standing, compression cures the disease either by obstructing the circulation in the diseased vessel, or by diminishing the force of the current of the blood in the tumour, and thus permitting the coagulation of the blood to proceed more rapidly.

In all cases of external aneurism, where there are no inflammatory symptoms or tenderness of the swelling, or where these have been completely subdued by local as well as general remedies, compression may then be considered as particularly applicable; but on the contrary, when the tumour is tender to the touch and accompanied with inflammation, any mode of using compression is highly improper; indeed, if employed under such circumstances, it will aggravate the disease which it is intended to remedy. Even under the most favourable circumstances, the cure of an external aneurism by compression will generally be found to be attended with many difficulties, and hence the number of cures which have been performed by this mode of treatment variously modified have been comparatively few, and the successful results, unfortunately so uncertain, have seldom been obtained without causing much suffering.

A certain degree of compression may, in some cases, be employed with great advantage to diminish the tension of the integuments, and may prolong the continuance of life by preventing the bursting of the tumour. For such a purpose an external aneurism may be covered over with strips of adhesive plaster, and these may be applied in such a manner as not only to form a protection to the parietes of the tumour by giving them additional thickness, but they may be applied so firmly, and cover the tumour in such a variety of directions, as even to diminish its bulk as well as to resist its further distension from the impetus of the blood.

OPERATIONS FOR ANEURISM.

By far the most certain mode of curing an external aneurism, when it can be with propriety adopted, consists in obstructing the flow of blood in the tumour by applying a ligature on the diseased vessel. Until the time of Hunter, the operations for the cure of aneurism were not only extremely dangerous and uncertain in their results, but were only applicable to the disease in a few of the arteries of the body. One mode of operating consisted in removing the contents of an aneurism, and then applying the actual cautery or graduated compresses to the extremities of the artery in the sac, and retaining them in that position by adequate pressure with a bandage, until there was no longer any risk of hæmorrhage; the sac was afterwards filled up by the process of granulation. Another method employed by the older surgeons was, to make an incision into the aneurismal sac, remove the coagula of blood contained within it, and then endeavour to tie the bleeding extremities of the vessel with a ligature. These operations, independently of the great difficulty in their execution, gave rise to numerous bad consequences, which, in a great majority of cases, where they were performed, led to a fatal termination.

There are *three* different modes of operating now employed for the treatment of aneurism, and the choice of each method depends on the particular artery, or on the particular portion of the artery which has become aneurismal.

The *first* of these modes of operating, consists in completely obstructing the circulation, by placing a ligature on the diseased artery, between the aneurismal tumour and the heart, or on the *cardiac* side of the tumour. The *second* consists in obstructing the circulation through an aneurism, by placing a ligature on the diseased artery between the aneurism and the capillaries, or on the *distal* side of the tumour; whilst the *third* mode of operating consists in not completely obstructing the circulation of the blood within the sac, but in diminishing its impetus, by placing a ligature on one of the branches of the diseased artery on the capillary side of the tumour.

The object to be effected by these different operations is either to form a complete barrier to the circulation of the blood in the tumour, or to diminish the impetus of the circulation to such a degree as shall permit the blood within the sac to coagulate.

When by any of these proceedings the aneurismal sac becomes filled with a coagulum of red blood, a fibrinous concretion is subsequently formed, and in proportion as the fibrine is deposited, so is the coagulated blood absorbed; and the concreted fibrine in its turn is gradually diminished in quantity, the sides of the sac approximate and coalesce, and ultimately the aneurismal tumour is greatly reduced in bulk, and is converted into a firm, solid, fibrous knot.

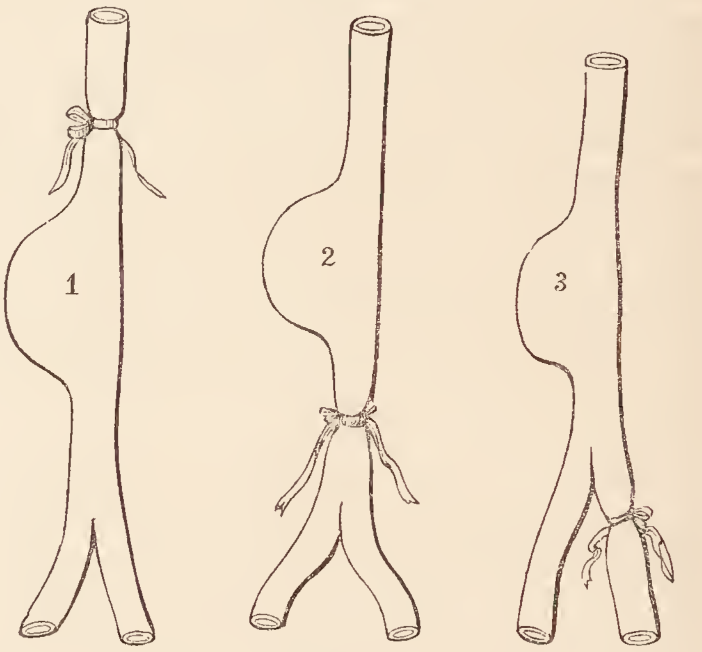
The *first* mode of operating, or that which consists of applying a ligature on the trunk of the aneurismal artery on the *cardiac* side of the tumour, was proposed and successfully adopted by John Hunter.

The *second* mode of operating, or the application of a ligature on the distal or capillary side of the tumour, was suggested but never executed by Brasdor.

The *third*, which consists in placing a ligature on one of the branches of the diseased artery on the capillary side of the tumour, was first suggested and executed by the author of this article.

These three different modes of operating are further explained in this diagram (fig. 64).

Fig. 64.



In the first, a ligature is placed on an arterial trunk on the cardiac *side of an aneurismal tumour. In the second, is represented a ligature placed upon an arterial trunk on the* distal *or* capillary *side of an aneurism. And the third shows the ligature placed upon only one branch of the diseased artery.*

We need only mention Anel's mode of operating as matter of history, as no British surgeon ever thinks of resorting to it at the present day. But if a surgeon should be so unfortunate as to open an aneurismal sac through mistake, the steps resorted to in this method will afford him his readiest resource against an immediate fatal termination. He should at once remove the coagula, and tie the mouths of the vessel, or plug up the cavity in the most effectual way he can. The cases of this kind that have been thus successfully treated, are by no means few in number. It may be here added, that in cases where the sac is large, nature will discharge the coagula by the formation of an eschar, the cavity, after suppurating, being filled up by granulations.

Hunter's mode of operating.—The operation for the cure of aneurism suggested by the ingenious Hunter, in 1785, has been justly considered as one of the greatest improvements which the history of surgery presents. That operation, consisting as I have already stated, in placing a ligature on the arterial trunk, between the aneurismal tumour and the heart, and at a distance from the aneurism, put an end, in a great degree, to the severity and danger attaching to the modes of operating which until that time had been adopted for the cure of the disease. It was now no longer necessary to lay open the cavity of the aneurism, or to place a ligature on a portion of a vessel, perhaps unsound; the difficulties of securing the mouths of the denuded artery were altogether avoided, and the parts deprived of their due supply of blood, in consequence of the obliteration of the arterial trunk, are immediately and abundantly supplied by the anastomosing vessels. The innovation of Hunter was no rash or blind experiment: adhesion and absorption, principles which he had so ably developed, were the physiological resources on which he relied, and the application of a ligature on the sound part of an artery, and at a distance from the aneurismal tumour, may be considered as natural a result of his admirable labours, as the principle itself of healing wounds, *by the first intention.* Hunter, having established the soundness of his principle of operating for popliteal aneurism, by obliterating the superficial femoral artery, others were emboldened, more particularly some surgeons in this country, to adopt the same principle in other aneurismal arteries, and thus modern surgery has been lately enriched by a series of bold operations for the cure of aneurism, ligatures having been successively placed on arterial trunks of the first order in magnitude. Thus Abernethy placed a ligature on the carotid artery, and afterwards on the trunk of the external iliac in an aneurism of the inguinal artery; — Keate tied the subclavian artery for the cure of an axillary aneurism;—Mott, of New York, applied a ligature to the innominata;— and, finally, Cooper placed a ligature on the aorta itself.

Unaware of the restorative powers of the economy, and of the office which the inosculating branches of the arterial system are capable of performing when the circulation through a trunk is obstructed, the possibility of a limb being nourished, after the circulation through so large a vessel as the femoral artery became obstructed, had never been contemplated, until it was proposed by Hunter to place a ligature on that vessel for the cure of popliteal aneurism. This principle of operating was, indeed, more especially applicable to the treatment of an aneurism of the popliteal artery, because here the old operations must have been very difficult to execute; whereas the ligature could be placed with great facility on the superficial femoral artery, and at a considerable distance from the tumour. Accordingly, when this mode was employed in an aneurism of the popliteal artery, though Hunter made use, as we now know, of an unnecessary number of ligatures, without tightening any one of them in a secure manner, the new operation was successful, and has since been universally performed in all cases of external aneurism, where a ligature can be placed on the *cardiac* side of the tumour.

If a ligature be applied on an arterial trunk on the *cardiac* side of an aneurism, the first effect of the operation is to cause a complete stoppage of the circulation of the blood within the sac—unless under some particular circumstances which will be hereafter mentioned. The blood then becomes stagnated, its coagulation readily takes place, and not only does the blood contained in the artery between the ligature and the tumour, and that contained within the tumour itself, undergo this change, but likewise the portion which is contained between the tumour and the first inosculating branch on the capillary side of the aneurism is coagulated. The circulation of the blood within the tumour having ceased, and its contents having coagulated, the progress of the disease is now arrested, and the tumour, in place of increasing, diminishes in bulk, and the whole of the coagulated blood is absorbed. A concretion of fibrine is afterwards formed within the sac and obstructed portion of the artery, the sides of the sac as well as those of the vessel gradually coalesce, and ultimately their cavities are obliterated.

Whilst these changes are going on within the sac, important changes are also taking place in the inosculating or anastomosing vessels. No sooner is the ligature placed on the arterial trunk than an immediate alteration takes place in the current of the blood. The increased impulse which is necessarily given to the heart's action, from the additional stimulus it receives by the increase in the quantity of its arterial blood, in consequence of the supply to a large trunk being obstructed, will assist in propelling the blood with greater vigour into the inosculating branches, so that they are at once enabled to fulfil the offices of the obstructed vessel, and abundantly to supply the limb with blood.

I have stated that the defective supply of blood in a limb, caused by the obstruction of an arterial trunk from the application of a ligature, is *immediately* balanced by the enlargement of the anastomosing vessels. That an increase in the size of the inosculating branches takes place as I have already stated, at least, to a certain extent, almost instantly after the trunk has been obstructed, is proved by an interesting circumstance, which I had first an opportunity of observing in a child on whom I placed a ligature on the external carotid artery. Immediately after the operation, the branches of the temporal and occipital arteries of the opposite side of the head could be distinguished through the delicate integuments, enlarging, becoming tortuous, and apparently circulating their contents with additional vigour.

To fulfil the office of a large arterial trunk, I have also mentioned that many anastomosing arteries appear at first to lend their assistance, but, sooner or later, the function of the obstructed vessel is performed by a very few inosculating branches, these acquiring a larger and larger size in proportion to the diminution in their number. The dissections of limbs, on the main arteries of which ligatures had been placed at different periods before death, point out those changes in the anastomosing vessels, and how the new channels become gradually diminished in number.

In one case, where the limb had been amputated some years after the femoral artery had been tied for a popliteal aneurism, an artery was found of apparently equal magnitude, and in the site of the original vessel. On examining the inferior extremity of a subject in the dissecting-room, of which no previous history was known, about three inches of the superficial femoral artery was obliterated, being converted into a ligamentous cord, in which there was no trace of a canal. The place of this artery was chiefly supplied by *one* of the branches of the profunda, the others not being much increased. This branch was equal in size to the superficial femoral in the opposite limb, and in the lower part of the thigh had nearly the same course with the remains of the superficial femoral, excepting that it did not pass through the sheath formed for the superficial femoral by the adductor longus and vastus internus muscles[1].

When the Hunterian operation for the cure of aneurism was first contemplated, it was undertaken on the principle that it would be followed by a *complete* stoppage of the circulation of the blood in the tumour. In some of the cases of popliteal aneurism, however, which were operated on by Hunter himself, and related by Home in the *Transactions of the Society for the Improvement of Medical and Chirurgical Knowledge*, it is stated that the tumour in the ham continued to pulsate for a considerable time after the ligature had been placed on the superficial femoral artery; and the conclusion he drew from that fact was, "that simply taking off the force of the circulation from the aneurismal artery is sufficient to effect a cure of the disease, or at least to put a stop to its progress, and to leave the parts in a situation from which the actions of the animal economy are capable of restoring them to their natural state."

Subsequent observations have shown, that the circulation in an aneurismal tumour may be continued, after the trunk has been tied, in two ways;—the one, in consequence of a branch or branches passing from that portion of the vessel situated between the ligature and the heart continuing open and communicating by anastomosis with other trunks; the other, by branches coming off from the artery at the distal side of the tumour, which branches anastomose with other trunks. But in whatever mode the circulation may have been kept up in the sac, the diminution in its force caused by tying the diseased trunk is sooner or later sufficient to insure the ultimate consolidation of the aneurismal tumour, except, as I have already stated, in a very few cases, wherein, in consequence of some unusual distribution of the arteries the current of blood in the aneurism continues to such a degree as not to permit either the coagulation of the blood, or the formation of a fibrinous concretion sufficient for that purpose.

Fig. 65.

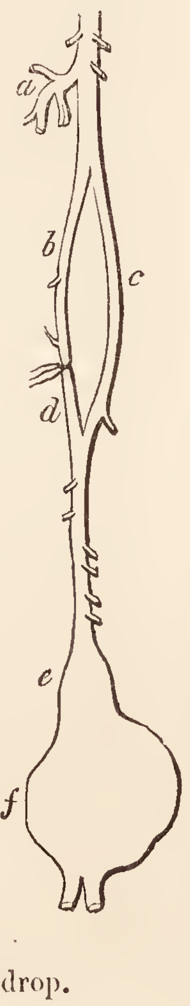


Fig. 65, *presents an anomalous distribution of the femoral artery; a is the profunda; b and c two branches, into which the femoral artery is divided; on one of which a ligature was placed at d; e and f is the aneurismal tumour of the popliteal artery.*

Brasdor's mode of operating.—Those aneurismal swellings which were so situated that the knife of the surgeon could not reach the artery between the tumour and the heart, being still, however, considered incurable, Brasdor, a professor of the ancient school of surgery, in Paris, was led to propose a mode of operating which he conceived might be applicable to some of those cases where the Hunterian operation was impracticable. The operation suggested by Brasdor was to place the ligature on an aneurismal artery upon the *capillary*, in place of the *cardiac* side of the tumour, in cases where no branch would intervene between the ligature and the sac. Dessault was in the habit of mentioning this proposal in his public lectures, and stated it as his opinion, that in a case of aneurism, where the position of the tumour was such as to render the Hunterian operation impracticable, Brasdor's proposal might be worthy of trial. But neither this justly celebrated surgeon, nor Brasdor himself, ever embraced an opportunity of performing it; and it was Deschamps, their contemporary, who first executed this new operation, though it was undertaken by him under the most unfavourable circumstances.

"A man sixty years of age had, in the superior part of his thigh, an aneurism seventeen inches in circumference, and there was not above a finger's breadth between the tumour and Poupart's ligament. Deschamps proposed to put a ligature on the artery on the capillary side of the tumour, hoping that the stagnation of the blood would cause its coagulation. The operation was performed, but was tedious and difficult on account of the pulsations of the artery not being distinguished. The progress of the tumour, which had been very marked immediately previous to the operation, increased so much after it, that upon the fourth day its rupture appeared at hand. It was then decided to adopt a second operation, and to tie the artery according to the ordinary method, notwithstanding all the considerations which had formerly prevented its being done. Compression was made against the pubes; and after opening the aneurismal sac, two ligatures were placed, one above and the other below the opening in the artery; the hæmorrhage was very great during the operation, and the patient died in eight hours."

Sir Astley Cooper was the next who made trial of this operation of Brasdor's, in a case of aneurism of the external iliac artery, which extended into the abdomen so high as to render it impracticable to tie the vessel on the *cardiac* side of the tumour. A ligature was, therefore, placed on the common trunk of the femoral artery between the origins of the epigastric arteries and the profunda. The pulsation of the tumour continued, but its bulk did not increase after the operation. On the contrary, it diminished so much that it was conceived if it continued to diminish it might then have been possible to have tied the internal iliac artery on the *cardiac* side of the tumour. The aneurism, however, burst, and the patient died in consequence of an extravasation of blood in the adjacent cellular membrane.

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[1] On Aneurism, by James Wardrop.

These two were the only cases during a period of more than forty years, in which this mode of operating for aneurism had been adopted; and from the unfortunate results with which they were followed, the operation of Brasdor fell into disrepute, and an attempt was even made to turn it into ridicule.

"I cannot conceive," says Burns, "a more futile idea than to suppose that such an operation could possibly tend to prevent the growth of an aneurismal sac: one might readily believe that it may, by preventing the blood from passing freely through the tumour, cause it to enlarge more rapidly than before. That it would occasion a firm coagulum of the contents of the aneurism, and consequently enlargement of the anastomosing branches; a diversion of blood from the tumour is what one would hardly expect, and least of all would any one imagine, that Dessault would have been the projector of such a doctrine, and Deschamps the first to put it to the test of experiment. In doing this, the latter had no reason to boast of his dexterity, nor could he say more of his success. Indeed, all circumstances considered, there is no point in the treatment of aneurism, which should be more decidedly reprobated than this: it is absurd in theory, and experience proves that it is ruinous in practice."

Opposed, however, to this opinion, Hodgson, in his Treatise on the Diseases of the Arteries, a work which has been justly esteemed one of the most useful contributions to modern surgery, advanced a very different opinion of the proposal of Brasdor. "From these observations," remarks that learned writer, "I think we may conclude that the effect of tying an artery immediately below (on the capillary side) an aneurism, in a case *where no branches* originate from the sac, or from the artery between the ligature and the tumour has not hitherto been determined by experience. The termination of the two cases in which this practice has been tried by no means destroys the probability of a happy result under other circumstances. There is strong reason to believe, that if *no branch* originated from the aneurism, or from the artery below the aneurism, the blood would coagulate in the tumour, and that a cure would be accomplished by the absorption of this coagulum and the subsequent contraction of the sac. The principle upon which a cure is expected to follow this mode of operating is the same as that upon which varicose veins are cured by tying the superior part of the vessel. The obstructed blood coagulates in the dilated vein; the coagulum is absorbed; the cyst contracts; and the disease is cured."

All speculation on the effect of Brasdor's operation was, however, set at rest, a favourable opportunity having occurred to myself in 1825, of performing an operation on this principle, in a case of Carotid aneurism[1]. A female, seventy-five years of age, having been for three months afflicted with anomalous pains in the neck, and great difficulty in respiration; after a violent fit of coughing she perceived a swelling on the right side of her neck, a little above the clavicle. The tumour had all the characters of a diffused aneurism of the carotid artery, and had become so large that it was quite impracticable to tie the vessel on the *cardiac* side of the tumour, so closely did it come in contact with the clavicle. The tumour continued to increase, and on the eleventh day after it was first observed it had acquired a formidable aspect, the skin covering the scapular portion having become very red and painful, the pulsation, which was very strong throughout the whole swelling, being here particularly so; the parietes feeling extremely thin, and appearing as if ready to give way.

The patient's life being in the most imminent danger, it forcibly struck me that it might be expedient to tie the carotid artery on the *capillary* side of the tumour. There were circumstances which made this case particularly favourable for resorting to such a measure; the aneurism had been but recently formed; the patient, though far advanced in years, was in all other respects healthy. Besides, the diseased artery was most favourable for the trial of Brasdor's operation, no branches being sent off from the common carotid until it divides into the external and internal, the process of coagulation would not be interrupted by the circulation through any collateral branch in immediate contiguity with the aneurism. The operation also appeared practicable in this instance, as the aneurism, though large, still left sufficient space for the application of a ligature between the tumour and the division of the artery.

There was no particular difficulty in reaching the artery, but what might have been anticipated from its great depth, from the necessary limits of the incision, and from the numerous large veins which were to be avoided, particularly one branch that extended across the middle of the incision to the internal jugular. The vessel appearing to be healthy, one ligature was firmly tied round it, as close to the tumour as the incision would admit; and the lips of the wound were stitched together. The aneurismal tumour itself was covered with adhesive plaster in order to protect the tender skin, and at the same time to keep up a certain degree of pressure; as I expected that the resistance to the circulation which the ligature would necessarily occasion, might, for a short while at least after its application be followed by an increase in the size of the tumour. Instead of which there was an immediate *diminution* of its bulk, which was marked by a considerable corrugation of the skin at the base as well as a decrease in its redness. The patient passed the night after more comfortably than that previous to the operation.

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[1] Case of Carotid Aneurism, successfully treated by tying the Artery beyond the Tumour, by James Wardrop, Trans. of Med. Chir. Society, 1825.

A progressive diminution in the bulk of the aneurism, and in the strength of its pulsations took place, so that on the fourth day after the operation it seemed to have diminished nearly one-third; the upper and tracheal portion had lost all pulsation, and only the scapular portion retained an obscure undulatory thrill. The integuments, which had lost their redness, now became more inflamed, and during the fifth and sixth days there was a distinct increase in the size of the tumour, and it pulsated more strongly, which seemed partly owing to several severe fits of coughing. This apparently unfavourable change was, however, followed by a decided amendment; for on the eighth day after the operation the swelling again began to diminish, and the pulsation became more obscure, so that on the fourteenth day it was not much larger than half its bulk at the time of the operation. No pulsation could be detected in any portion of it, and merely a slight vibration was perceptible in some parts which seemed to be produced by the pulsations of the contiguous vessels, which were now enlarged, particularly the inferior thyroid artery.

The redness of the skin, however, continued to increase, and that of the scapular portion of the tumour to become more and more of a purple colour, till, at last, ulceration commenced on its most prominent part. Several considerable-sized portions of coagulated blood were now discharged along with some healthy pus through the ulcerated opening; and on the twentieth day after the operation the ulceration of the integuments had closed, and nothing of the tumour remained, but some wrinkling of the skin, and a considerable degree of thickening of those parts on which the base of the tumour had rested. These symptoms continued to diminish, and at the end of the fifth week from the time of the operation the neck had nearly assumed its natural form, a slight degree of inequality only remaining: the ligature had come away, and the patient's general health, on the management of which the greatest care had been bestowed, was now completely re-established. This patient visited me in perfect health four years after the operation.

Since that period, Brasdor's mode of operating has been adopted by Bush, Lambert, and Montgomery, in cases of carotid aneurism, and the result of their operations has not only proved the soundness and practical utility of the principle, but has made us acquainted with some remarkable changes which take place in an aneurismal tumour when a ligature is applied on the trunk of an artery at the *distal* side of an aneurism, and that no branch intervenes between the ligature and the sac,—phenomena which, in many respects, are quite different from what had generally been supposed as likely to take place, from any previous reasoning on the subject.

Had, indeed, the principle on which this operation was suggested been strictly correct, or were it indispensable for the cure of an aneurism by Brasdor's mode of operating, that no branches should originate either from the sac or between the ligature and the sac, it is evident that practical utility must have been very limited, aneurisms being seldom met with in a situation where this mode of operating could be employed. The carotid artery is perhaps the only vessel in which an aneurism could occur wherein Brasdor's suggestion could be fairly adopted,—an aneurism which not only is very rarely met with, but which had been considered of so formidable a character as to have been supposed beyond the reach of surgery until many years after Brasdor's proposal had been made.

When, as in Hunter's operation, a ligature is applied on an artery between the aneurism and the heart, or on the *cardiac* side of the tumour, the whole mass of blood in that part of the vessel between the ligature and the tumour, as well as the blood which is contained in the tumour itself must cease to circulate, and the ligature has to make a sufficient resistance to withstand the impulse of the blood in the cardiac portion of the vessel, until the internal clot and the adhesions of the sides of the artery at the point of ligation are sufficient to prevent hæmorrhage. The blood in the tumour itself then coagulates, and the subsequent diminution, and the consolidation of the aneurism afterwards, take place more or less quickly. Now let us consider what happens if a ligature be placed on the capillary or *distal* side of an aneurism, and in a case where no branch either passes directly into the tumour, or comes off from the trunk of the artery between the tumour and the ligature. No sooner is the ligature applied in such a case, and the usual course of the blood's circulation interrupted, than the anastomosing vessels dilate, and perform the function of the obstructed arterial trunk, in like manner as takes place after the Hunterian operation. It might indeed have been expected, that whenever the ligature was tied, the resistance thus given to the circulation would cause an increased effort in the vessel to propel its contents, not only against the point of resistance caused by the ligature, but likewise against the parietes of the sac. Any increase of impetus in the blood, however, can only continue a very short time; for as I have previously pointed out, when an artery is either divided or tied, anastomosing branches freely carry on the circulation; and the cases in which the operation of Brasdor has been performed, where the tumour was large, prove that instead of increasing in size after the artery was tied on its distal side, the swelling in a few minutes diminished considerably—a circumstance which was satisfactorily ascertained by the skin which covered it, and which was tense and ready to burst before the operation, immediately forming into wrinkles as soon as the ligature was applied upon the artery. If the current of the blood be thus turned into a new channel, the aneurismal sac, as well as the portion of the artery extending between the aneurism and the ligature, will now be in a passive state; and though the blood may continue, for a certain time, to be influenced by the impulse of the circulation which is carried on in that part of the vessel which passes into the tumour, still its current must become, not only irregular, but extremely languid—a condition which we know will admit of its being speedily coagulated. Whenever the coagulation of the blood in an aneurism does take place, then the cure of the disease may be said to be accomplished; a fibrinous concretion is deposited, and the sac contracts; or if the quantity of coagulated blood be very great, some clots may be discharged through the skin by a process of suppuration, the fibrine formed within the sac will be ultimately absorbed, and the aneurism consolidated.

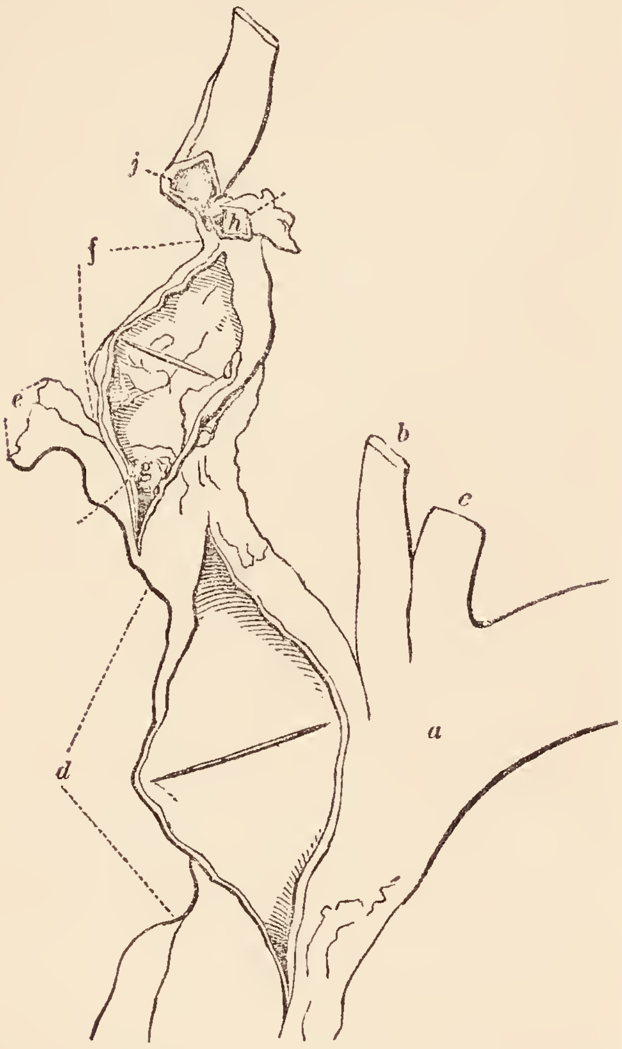
Let us next consider the difference in the condition of the blood which is contained in an aneurism, when a ligature has been placed on the cardiac, as compared with that in which it is found when a ligature has been placed on the distal or *capillary* side of the tumour. If the ligature be applied on the cardiac side of an aneurism, as the blood cannot be propelled from the sac through the capillaries of the artery, which is obstructed by the ligature, it must remain there until it be either absorbed or evacuated by a process of inflammation and ulceration of the tumour and its adjacent integuments. But when the ligature is placed upon the capillary side of an aneurism, there is an immediate diminution in the bulk of the tumour, the fluid blood within it can find, under such circumstances, a ready exit into the arterial trunk, along which it had passed, and thus, again, it gets into the circulation, in place of, as in the other case, having no exit but through the capillaries; and no more blood can be afterwards impelled into the tumour, a new channel for carrying on the circulation being immediately established.

This diminution in the bulk of the aneurismal tumour, a point so clearly established by a reference to all the cases wherein Brasdor's operation has been employed, is one of great importance, and ought to be taken into consideration in operating for aneurism in those cases where the ligature, according to the choice of the surgeon, may be applied, either on the cardiac or capillary side of the tumour. In two cases of carotid aneurism, where the ligature was placed on the cardiac side of the sac, both patients died from an increase in the size of the tumour, which took place after the operation. It would therefore seem, that when the ligature is placed on the *cardiac* side of an aneurism, the contents of the sac are not diminished, but a congestion takes place of all the blood which it may contain at the time of the operation; whereas, when a ligature is applied on the *capillary* or distal side of the sac, an immediate and permanent diminution is produced in the bulk of the tumour. In the cases of carotid aneurism, where the ligatures were placed on the *cardiac* side of the sac, the cause of death was attributed "to the inflammation of the aneurismal sac and parts adjacent, by which the size of the tumour became increased, so as to press on the pharynx and prevent deglutition, and upon the larynx so as to excite violent fits of coughing, and ultimately to impede respiration." (*A. Cooper.*) This congestion and subsequent inflammation of the sac are therefore to be considered as serious evils attending the Hunterian operation,—evils which are in a great degree avoided when the ligature is placed on the capillary side of the tumour.

It is not one of the least important advantages of Brasdor's mode of operating, that the risk of *secondary hæmorrhage* will be less than when the operation is performed according to the method of Hunter. The ligature, it is clear, has to fulfil a very different office, when placed on the capillary side of an aneurism, from that which is required of it when placed between the aneurism and the heart. Instead of stemming a strong current of the blood, until an internal clot is formed, and the sides of the artery adhere, the ligature, when placed on the capillary side of the sac, has to make resistance to the current of the blood during a few minutes only, for the blood receiving a new direction, the circulation in the tumour becomes extremely languid immediately after the ligature is applied, as is proved by the instantaneous diminution in the bulk of the aneurismal tumour. The blood, too, which is contained in that portion of the artery between the ligature and the sac, must also stagnate, and soon coagulate, thus forming a complete barrier to all future circulation, and rendering any further assistance from the ligature unnecessary. So much must this be the case, that were there any useful purpose to be served by it, the *temporary* ligature would be particularly applicable in Brasdor's operation.

In one of the cases of carotid aneurism, where Brasdor's mode of operating was adopted, and it is the only one which proved unsuccessful, the patient was lost from hæmorrhage; but it is important to remark, that the blood, in this instance, escaped from the *capillary*, and not from the cardiac orifice of the artery; the aneurismal sac, and the portion of artery between the sac, and the ligature being filled with concreted fibrine, and impervious (fig. 66).

Fig. 66.



All these changes in an aneurismal artery, on which a ligature has been placed on the capillary *side of the aneurism, are explained in this figure. From the arch of the aorta (a) is seen coming off the left carotid artery (b), the innominata laid open (d), a portion of the right subclavian (e), and above it the aneurismal sac (f) of the carotid is laid open, in which there is a mass of firm coagulum, filling up completely the cardiac orifice of the sac (g), and the parietes of the sac itself are much thickened with concreted fibrine: (j) and (h) are two orifices of the artery formed by the ulceration of the ligature; the cardiac orifice (h) being filled with a coagulum, whilst the capillary orifice (j) remained quite pervious.*

The ligature, therefore, in this mode of operating for a carotid, or any other aneurism, where no branch comes off between the sac and point of ligation, has a double office to perform, viz. to prevent the escape of blood, both from the cardiac and capillary orifices of the artery, and it is evident that the risk of hæmorrhage from the cardiac orifice, which is so considerable in Hunter's operation, is by no means so great in that of Brasdor's. But independently of this, the fact itself, that hæmorrhage may take place from the capillary orifice in the vessel, whether the ligature be applied on the cardiac or on the distal side of the aneurism, illustrates the change produced in the state of the circulation of the blood when an arterial canal is obstructed, and it also points out that there is a retrograde motion of the blood in the portion of artery on the capillary side of a ligature, the branches of the obstructed trunk acquiring a power to transmit blood in a direction opposite to its natural current,—the retrograde motion of the blood being somewhat analogous to the anti-peristaltic motion of the alimentary canal. Indeed, the circumstance that there sometimes is a retrograde motion of the blood in an artery on the capillary side of a ligature deserves consideration in determining the mode of applying ligatures, there being often greater danger of secondary hæmorrhage from the capillary than from the cardiac orifice of the artery at the point of ligation.

Nature employs the same process to prevent hæmorrhage from both orifices, and therefore it is requisite that a sufficient portion of the vessel should intervene between the ligature and first ramification of the artery to permit the formation of an internal clot on both sides of the ligature.

The author's mode of operating.—When speaking generally of the different operations which are employed for the cure of aneurism, I mentioned that besides the two modes of operating, those of Hunter and Brasdor, there was a *third*, which was suggested and executed by myself in 1827; a mode which is more particularly applicable to the treatment of aneurisms so situated that neither the operation of Hunter nor that of Brasdor can be performed[1]. The operation, as has been briefly stated, consists in placing a ligature *on one of the branches* of the diseased artery instead of on the trunk of the vessel itself. I shall here explain the principle of this operation, as well as the circumstance which led me to propose it,—giving likewise an account of the cases in which it has been performed.

Though it had been satisfactorily shown, both from certain symptoms which existed during life as well as by an examination of the diseased parts after death, that a popliteal aneurism could be cured even when subsequently to the operation of tying the superficial femoral artery a stream of blood continued to flow through the sac, still a knowledge of that circumstance did not lead to any practical result, or any alteration in the Hunterian mode of operating. The fact of the subsidence of an aneurismal swelling, and in some instances even of its ultimate consolidation, were sufficient to warrant the general adoption of Hunter's plan.

The process of a "spontaneous cure," or the means which the economy employs to prevent the bursting of an aneurism, might have, indeed, afforded sufficient proof that coagulable lymph, or the fibrine of the blood, can be deposited within the sac of an aneurism without any very great languor in the circulation, or diminution in the momentum of the blood. Unless, perhaps, in some very small aneurisms, wherein the internal and middle coats of the artery remain entire, in no case do we ever find the sac of an aneurism without a concretion of laminated fibrine.

The circumstance that an aneurism could

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[1] On Aneurism, with an Account of a new Operation for its Cure, by James Wardrop, 1828.

be cured by the Hunterian method of operating, notwithstanding a languid circulation had continued in the sac, along with the pathological facts here mentioned, was not, however, taken into consideration by those surgeons who had advocated the propriety of adopting Brasdor's method; on the contrary, they imagined that a ligature could not be successfully applied upon an artery on the distal side of an aneurism, if any branch intervened between the ligature and the sac; and thus assuming that the mode by which a ligature placed on an aneurismal artery cured the disease, could only be by causing a stagnation and subsequent coagulation of blood within the sac, they naturally inferred that a stream of blood, however small, through the tumour, would prevent such coagulation taking place. Alluding to the case operated upon by Deschamps, and the cause of its failure, Hodgson observes:—

"If a stream continued to pass through the aneurism into branches which originated below it, the blood contained in the tumour was *not at rest*, and consequently did not coagulate; a cure *could not*, therefore, be expected to ensue on the principle which led to the performance of the operation." And again, "It must be acknowledged, however, that it will be almost impossible in any case to ascertain that *no branch* arises from the sac, which by continuing the circulation through the latter, may defeat the objects of the operation."

From the important pathological fact, that in the processes which are employed by Nature for effecting the "spontaneous cure" of an aneurism, and likewise from the circumstance, that in some cases of popliteal aneurism, where the Hunterian operation had been performed, a complete stoppage of the circulation of the blood within the tumour had not been required, it appeared to me a legitimate conclusion,—that the progress of an aneurism might be arrested, or even the tumour consolidated, by placing a ligature *on one of the branches* of a diseased trunk.

It being admitted that a diminution in the force of the circulation of the blood, through an aneurismal sac, was sufficient to cure the disease, the important question still remained to be determined,—to what degree is it required to diminish the momentum of the circulation through an aneurism in order to permit a fibrinous concretion to be formed within the sac?

Here it is of importance to observe the difference between a coagulum of red blood and the concrete fibrine formed within an aneurismal sac, as the formation of each must be the result of a very different process. The word *coagulum*, as I have already noticed when speaking of the anatomical characters of aneurism, has been commonly employed to express both coagulated red blood and concreted fibrine, and, therefore, when we speak of the artificial means of effecting a coagulation of the contents of an aneurism, we ought to discriminate whether such means are required to promote the formation of a fibrinous concretion, or merely to produce a coagulation of the red blood within the sac. According to the principles of operating, both of Hunter and Brasdor, their operations were adopted with the conviction—that by putting a complete stop to the circulation in the tumour, there would be not only a stagnation but a coagulation of the red blood within the sac. It is quite evident, however, that in those cases of popliteal aneurism, where a curative process was established by tying the superficial femoral artery, and in which a stream of blood still continued to pass through the sac, no coagulum of red blood would be formed, but the parietes of the sac would be thickened, or its cavity ultimately obliterated, by the deposition of fibrine. It is equally clear, that in all those aneurisms in which a "spontaneous cure" has been effected, or where an effort has been made by the economy to prevent the rupture of an aneurismal sac by the addition of new matter to its parietes, that new matter is not coagulated red blood, but invariably consists of a succession of laminæ of organized concreted fibrine.

That a very moderate degree of diminution in the impetus of the circulation in an aneurismal sac is sufficient to allow fibrine to be effused within its parietes, seemed to me proved from the pathological facts which have been pointed out, when speaking of the spontaneous cure of the disease, and more especially from having observed, in an aneurism of the innominata, that Nature had arrested the progress of the tumour, by obliterating the carotid artery.

In examining, likewise, the cases where a "spontaneous cure" had taken place by a barrier to the circulation of the blood in the sac being formed by an obstruction in the vessel on the capillary side of the aneurism, it was evident that a process of coagulation in the aneurismal sac must have commenced at a time when the momentum of the blood within the sac could have only been diminished in a very slight degree, no greater change having taken place in the force of the circulation than might be supposed to be the effect of an enlargement of the arterial tube at the diseased part. Neither could it be supposed that the arteries which were obliterated in the cases alluded to, had undergone any thing like a sudden obstruction; on the contrary, whatever was the process, the arterial canals appeared to have been gradually obstructed; this being indicated by the slow diminution in the force of their pulsation during life. But besides the phenomena already stated, no circumstance appeared more conclusive in pointing out this diminution of the blood's momentum to have been very slight, than laminated fibrinous concretions being often found within aneurismal sacs of so small a size, that the change in the velocity of the circulation within them must have been very inconsiderable.

From the knowledge of all these important pathological facts, therefore, I was led to conceive the probability of being able to cure an aneurism by placing a ligature upon *one of the branches* of the diseased artery.

A case of Aneurism of the Innominata soon occurred, which afforded a favourable opportunity of testing this new mode of operating. Nature had already instituted a curative process in this case, the circulation in the right carotid artery having diminished to such a degree that its pulsations were scarcely perceptible. This circumstance alone not being sufficient to put a stop to the increase of the bulk of the aneurism, I thought it probable that, by placing a ligature on the subclavian artery, I should be strictly imitating the process which Nature herself had commenced, and that by thus further diminishing the force of the circulation, a coagulum would be allowed to form within the sac. A portion of blood, however, would necessarily continue to pass along the innominata, even after the subclavian artery was tied, and a stream would continue to flow through the sac, and supply those branches of the subclavian on the cardiac side of the ligature, it being all but impracticable to place a ligature on the subclavian until it emerges from between the scaleni muscles; such, however, I anticipated, would be the diminution in the impetus of the blood through the sac, that the process of coagulation and consolidation of the tumour would not only proceed, and its future increase be prevented, but that even a permanent obliteration of the aneurismal cavity would be accomplished.

Fig. 67.

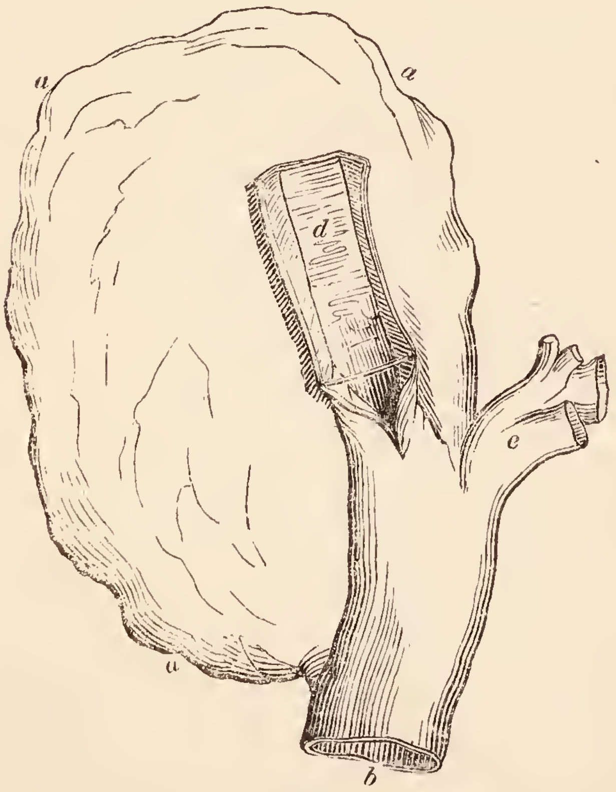


Fig. 67 *is an aneurismal tumour of the arteria innominata, which by its pressure had obliterated the carotid artery;* (*a a a*) *the outline of the aneurism, comprehending nearly the whole length of the innominata;* (*b*) *the trunk of the innominata;* (*c*) *the subclavian, with its branches; and* (*d*) *the carotid laid open, its sides were compressed by the aneurism, but its canal remained pervious, except at its termination in the sac, where it was completely shut up by a thin delicate membrane, apparently a continuation of the membrane lining the sac.*

An aneurism of the arteria innominata appeared to me, indeed, particularly suitable to make a trial of this principle of operating; and I was led to this opinion from having examined a case where the coats of the sac of an aneurism in that artery were thickened with fibrinous concretions, and in which the right carotid had been completely obstructed not only by the pressure of the tumour with which it was in close contact, but likewise by a delicate false membrane covering the orifice of the vessel where it arose from the sac; the effect of the obliteration of the carotid must in this case have been to diminish the circulation of blood through the aneurism at least one half, a diminution quite sufficient to cause that languor of the circulation necessary to permit of the formation of a coagulum within the sac. I had also met with a case where Nature had absolutely accomplished the consolidation of an aneurism of the innominata by closing up the subclavian as well as the carotid artery.

It therefore appeared to me that in the patient with aneurism of the innominata then under my care, and in whom the circulation through the carotid was already greatly diminished, if not altogether interrupted, to place a ligature on the subclavian would be a proceeding in strict imitation of the spontaneous process to which Nature resorted for the cure of aneurism of the arteria innominata in the case to which I have just alluded. It was also a matter of consideration as to this patient, that the tumour had been increasing so rapidly that her life was in imminent danger, and though I was apprehensive that the aorta was also implicated in the disease, yet the uncertainty in the diagnosis of such cases, and a knowledge of the fact that persons may live for many years with the aorta in a diseased condition, impressed me with the propriety of placing a ligature on the subclavian artery in this case. The operation itself was one of no great danger, and as there was no other means of prolonging life, I considered the trial of the measure justifiable.

In this case of Mrs. Denmark there was a pulsating swelling the size of a turkey-egg, whose base was situated under the clavicular edge of the sterno-mastoid muscle, and where the bellows' sound could be heard. She experienced severe pains, extending through the left side of the head and neck, and a disagreeable sensation of throbbing in the tumour. She had at times great difficulty of respiration, which increased on the slightest motion to such a degree as to produce a sense of impending suffocation; and her nights were very restless and disturbed, sleeping but for short periods, and being often obliged to get out of bed. Her countenance bespoke great anxiety, and her complexion was pale and sallow.

The disease had commenced, eleven months before, with difficulty of respiration, cough, and severe pains in the chest, head, and neck, which she considered to be rheumatic. About five months afterwards, she accidentally observed, when washing her neck, a pulsating tumour above the sternum, which very slowly, but perceptibly, increased, and it was attended by violent and distressing throbbings. Small bleedings were then frequently had recourse to; she took digitalis, was kept on a low diet, and in a state of the most perfect quiet. This plan of treatment alleviated the severity of the symptoms, and seemed to stop the progress of the disease. The tumour, however, soon increased most rapidly in bulk, giving rise to great difficulty of respiration, cough, distressing sense of suffocation, and violent throbbing in the tumour and neck; the integuments covering the apex of the swelling had also become painful. Accordingly, on the sixth of July (1827), I performed the following operation:—

The arm was placed downwards and backwards, and the head turned to the left side. I found great advantage from placing a solid semicylindrical block of wood under the neck, for securing the head in a steady position. Two incisions were made through the integuments—one parallel to and immediately above the clavicle, fully four inches in length; and the other parallel with, and immediately above the edge, of the clavicular portion of the mastoid muscle. These two incisions met at an angle upon that muscle close to its insertion in the clavicle; the superior termination of the incision extended close to the external jugular vein, which was not endangered. Instead of first dissecting back the skin, then the platysma myoides, and the cervical fascia successively, I made the incision at once through these parts, safely guided in doing this by cutting down as deep as the fibres of the sterno-mastoid muscle. I was thus enabled, by one dissection, to raise a triangular flap composed of skin, platysma myoides, and fascia. By this method, the supra-clavicular space was distinctly exposed, and the numerous veins and arteries were only once divided. I allowed the bleeding of these, which was by no means profuse, to cease; and it was not necessary to tie any of the divided vessels. The remaining part of the operation was performed with a blunt-edged silver knife, and so trifling was the hæmorrhage, that every part concerned in the subsequent steps of the operation could be distinctly seen.

The fat which fills up the supra-clavicular cavity, in which the subclavian artery lies, was pushed aside, and the deep fascia which extends between the omo-hyoideus muscle, and the first rib, and which in this case was remarkably strong, was exposed. A single silk ligature of moderate thickness was tied round the vessel; the wound was closed up by a few stitches and adhesive plaster. The pulse at the wrist now ceased; no pulsation could be detected in the right carotid artery or its branches. There was an immediate relief in her breathing, which became free and tranquil; and this change was more striking, as during the preceding twenty-four hours she had suffered an unusual degree of suffocating dyspnœa. The peculiar sensations which she complained of in her head were also removed. Although it could not be positively asserted that the tumour diminished, there was certainly no increase of its size, and the patient herself distinctly expressed, that she felt a decided diminution in the force of the beating; and this was confirmed by my own observation.

Twenty-four hours after the operation a very slight pulsation could be observed at the wrist, which continued without an increase of force; the temperature of the arm was not altered. The remarkable relief which she experienced in her breathing continued, as well as the diminution in the throbbing of the tumour, immediately after the operation; neither did the uneasy feelings in her head return. She also enjoyed very refreshing sleep, of which she had long been deprived. The anxious character of her countenance entirely subsided, and there only remained that appearance which belongs to a person who has undergone considerable depletion.

The operation was not followed by any febrile excitement; and, although the pulse continued rather more full and frequent than natural, the skin remained cool and moist, the tongue clean, and the bowels perfectly regular.

On the ninth day after the operation, a pulsation became perceptible in the *carotid artery*, which gave rise to much speculation. Some were inclined to consider it owing to the inosculation of the vessel with those of the opposite side, the blood thus arriving at the trunk from its extreme ramifications. This opinion seemed to be strengthened by the fact, that the pulsation was at first stronger in the temporal branch, than in the carotid itself. It seemed to me, however, more natural to account for this circumstance, by supposing that the aneurismal tumour, which formerly rose high in the neck, had, previous to the operation, compressed the carotid, and thus prevented the circulation of blood through it; and, that the swelling having now, by the effects of the ligature, become greatly diminished, the pressure had ceased, and a free course now existed for the trajet of the blood. Whatever explanation may appear the most likely, the occurrence itself could not be regretted, since the tumour having continued gradually to diminish, it tended only to prove more completely the truth of those principles which I advanced, and from a knowledge of which the operation was suggested; and although, had the vessel been altogether blocked up, the aneurismal tumour would by this time have completely disappeared, yet, even with the circulation of blood through the carotid, that event would in all probability ultimately arrive. Be that, however, as it may, the patient was brought from a state of great suffering, to one of comfort, bordering on health.

On the 22nd day, the ligature came away, and the wound healed; and one month subsequent to the operation, Mrs. Denmark left London, with the view of establishing, through the influence of open air, gentle exercise, and milk diet, the more complete recovery of her health, which, from the time the operation was performed, had been gradually improving, so that at the period of her removal she had no complaint, except a great degree of weakness and emaciation, which, independently of the existence of the aneurism, might have been produced by the long confinement and rigid depletory treatment to which she had been subjected. The only symptoms of the original disease which still remained, were a considerable degree of difficulty of respiration, much aggravated by walking, and a slight, scarcely perceptible pulsating enlargement, immediately above the sterno-clavicular articulation.

The distressing cough, sense of impending suffocation, severe pains in the neck and shoulder, the constant head-ach, and the tumour, which at the time the ligature was applied to the artery had attained the size of a turkey-egg, had all now very nearly disappeared, the wound had healed, and indeed hardly a mark remained to point out the former existence of the aneurism.

In this condition she went to the country, and derived immediate advantage from the change. Her strength daily increased, the dyspnœa in a corresponding degree diminished, and her general appearance improved perceptibly to those around her. In the course of a very short time she was able to walk out into the open air, and the severity of the dyspnœa had now diminished so much, that she could ascend a staircase with comparative ease.

The pulsation of the right carotid artery was now distinct, though by no means so strong as that of the left. The radial artery of the right side was scarcely perceptible, while that of the left conveyed a peculiarly hard thrilling sensation. On application of the stethoscope to the thorax, the pulsations of the heart were found to be natural, but at the upper portion of the sternum, a slight impulse was perceived, as if arising from some considerable enlargement of the origin of the arteria innominata. This impulse was, however, scarcely to be discovered, except after the patient had been making some bodily exertion, or when her mind had been agitated, more especially by questions which excited a suspicion of the existence of any supposed danger. Her countenance had lost entirely that anxious expression which was formerly so remarkable; and indeed her whole appearance bespoke the enjoyment of tolerable, though feeble, health. She had been attacked, after exposure to cold, with a severe bronchitis, and a consequent return of the dyspnœa to a great degree, which rendered the abstraction of blood necessary; by means of which, and attention to diet, she regained a nearly perfect state of health. On her return to London, it was found that not a vestige of the aneurismal tumour remained, the dislocation of the clavicle no longer existed, and all the distressing symptoms of her alarming disease had vanished.

Soon after, without any assignable cause, Mrs. Denmark was again attacked by a severe bronchitis, which, whether from the disorder arising from the state of the coats of the aorta increasing, or any impediment to the circulation of the blood which might exist from the closure of the subclavian artery, produced symptoms of an alarming character. The bronchitic affection having continued for two days, I found her labouring under a degree of dyspnœa so great, as entirely to prevent her lying down, and producing a most agonising sense of impending suffocation. She had a frequent cough, which was accompanied with copious expectoration of a frothy mucus; the pulse was about 130, and wiry; the skin was hot, and there was great febrile derangement, accompanied, towards midnight, with high delirium. She complained much of the sensation of impending suffocation, which was accompanied with a slight difficulty in deglutition. There was also present slight œdema of the feet. On examining the neck, no tumour could be found in the situation of the former aneurism, nor were the pulsations of the aorta and heart more strongly felt than before the occurrence of this severe attack, nor, indeed, did any symptom appear to indicate that the disease in the vascular system had increased. Under these circumstances she was largely bled, leeches were applied to the chest and feet, and she was kept constantly under the effects of nauseating doses of the tartrate of antimony. During the course of the next day, she was again twice largely bled, once cupped in the region of the sternum, and the action of the antimony was continued. From this treatment she experienced considerable relief; but during the course of the three succeeding days I found it necessary to repeat the venesection. She was now reduced to a very weak condition; but although the pulse had sunk nearer to the natural standard, and the febrile action had greatly subsided, yet she still experienced a remarkable degree of difficulty in breathing, accompanied with the feeling of suffocation, which had so alarmed her. The cough was still very frequent, and accompanied with more copious expectoration. She was, during the next week, kept extremely low, and again bled, after which she began to revive, and her difficulty of breathing became considerably relieved, but still it was so difficult that she was unable to lie down, and always slept propped up in bed.

She continued in a very weak and precarious state for several weeks, during which time the difficulty of respiration frequently increased to such a degree, as to render the abstraction of blood necessary. For two months she was unable to rise out of bed, and during all that time was affected with a greater degree of difficult respiration, cough, and expectoration, than she had ever experienced, except at the commencement of the attack. At this period, to such a state of weakness and emaciation had she been reduced, that a female friend, who came from a distance to see her, fainted the moment she beheld the altered condition of her person. She now, however, began gradually to recover, was able to sit out of bed, and her respiration became more free; but she was still unable to sleep in the horizontal position. During the whole period of this severe illness, no appearance of any pulsating swelling could be discovered in the site of the former aneurism, nor did the aorta or the heart betray any symptom of disease. It ought here to be observed, that from the time of her return from the country, to the commencement of this illness, she had not been bled; and perhaps the cessation of an evacuation, to which she had long been habituated, may have had some effect in producing the severe attack of bronchitis. I thought it therefore advisable, in order to prevent any recurrence of this complaint, to repeat the bleedings frequently, particularly as she was sensible that they always afforded her great relief.

It is of importance to observe, that from the commencement of my attendance on this patient, she had up to this period been bled above fifty times, to an extent at each operation seldom less than a pint of blood, and frequently to nearly double that quantity.

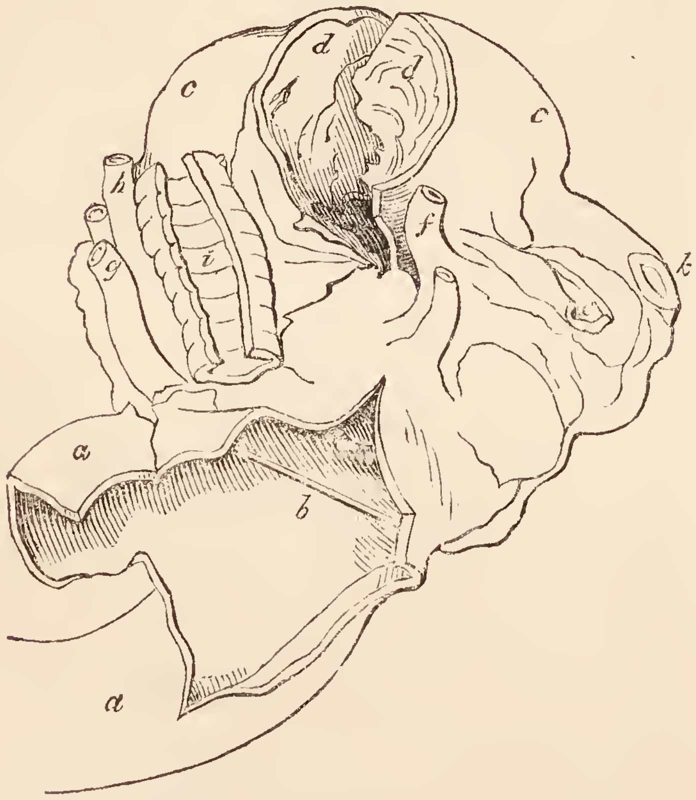
This treatment was persevered in for six weeks, and she regained her former appearance in a wonderful manner. The difficulty of respiration diminished greatly, so much so, that she could sleep in the natural position, and she was entirely free from the dreadful sensation of threatened suffocation. No tumour was now perceptible in the site of the former aneurism, but an unnatural feeling of hardness could be perceived at the root of the neck, immediately above the sternum, arising, no doubt, from a consolidation of the aneurismal tumour. The right carotid artery still pulsated, although not so strongly as the left; but its branch, the temporal artery, afforded no indication of the circulation of blood, and the right radial artery beat with about half the strength of the left. She suffered none of those pains in the regions of the neck, shoulders, and back; nor had she, for a long time, experienced any of the severe headaches which formerly gave her so much uneasiness, the œdema of the feet had entirely disappeared, and she was able to take exercise in the open air daily.

For some time after this period no change took place in Mrs. Denmark's condition; but she occasionally suffered from severe attacks of dyspnœa, which were generally relieved by blood-letting. In about three months, however, a swelling was perceived immediately above the sternum, and a tumour arose which, as it advanced, occupied the centre of the neck, and covered the inferior portion of the trachea. In the course of some months afterwards a second tumour made its appearance in the site of the root of the right carotid artery, and extending up the right side of the neck. These two newly-formed swellings were so intermingled at their base with the firm and consolidated remains of the original aneurism, that the whole formed one formidable mass, the limits of which could not be ascertained by the touch, and could only be a matter of conjecture. Many opinions were hazarded as to the origin and precise site of this tumour; my own opinion, however, remained unaltered, and I now deliberated on the propriety of tying the right carotid artery. It must be recollected that when I first contemplated obliterating the subclavian artery in this case, I did so from the conviction that Nature had already obliterated the right carotid, that vessel having long ceased to pulsate, and although sufficient time had elapsed from the application of the ligature on the subclavian artery to allow the process of coagulation in the tumour, yet when the circulation through the right carotid was observed, on the ninth day after the operation, to be imperfectly restored, the occurrence was most unexpected; nevertheless, the aneurismal tumour continued to decrease, and its distressing symptoms to become alleviated.

However firmly I adhered to the original opinion I had formed of the seat of this aneurism, there were some surgeons in whose discrimination and judgment I placed great confidence, who were dubious of the precise site of the tumour. Such doubts, in a case of so difficult diagnosis, together with a consideration of the severity and danger of tying the carotid artery, even under the most favourable circumstances, were to me sufficient reasons for not performing that operation; I therefore endeavoured merely to mitigate the symptoms by a rigid system of depletion. The aneurism continued for some time to enlarge, after which very little alteration in the state of the tumour took place. Respiration and deglutition were both impaired, and there was a copious secretion of watery mucus from the bronchi. The patient's general health varied; she was sometimes comfortable and cheerful, at others, languid and feeble. About two months before her death general anasarca came on, and when it had increased so much as considerably to distend the integuments, the fluid drained off from an opening in the inferior extremity. During this period, she became considerably weaker, and was at last attacked with a violent diarrhœa; which, although checked soon after its accession, reduced her so much that she gradually became more and more exhausted, and expired twenty-three months from the time the operation was performed.

On examination after death, the bulk of the aneurismal swelling had not diminished. After removing the integument of the neck, the tumour was found to occupy the central space between the two sterno-mastoid muscles, and the sternal portions of each of these muscles lay over the sides of the tumour. The mass may be said to have been composed of three divisions; one sternal, arising immediately above the sternum, another passed upwards along the trachea, and the third was the original portion of the aneurism which had become consolidated after the operation. These three masses had formed in conjunction a lobulated tumour larger than a turkey-egg. It adhered firmly to the sternum, and a portion of that bone was absorbed. The aneurismal tumour, as might have been expected from its bulk not having been diminished after death, felt like a firm fleshy mass. On laying it open longitudinally it appeared nearly solid. The coats of the sac presented the usual appearance observed in true aneurism, and the clavicular and tracheal portions of the sac were filled up with a firm fibrinous concretion, leaving a cavity only about the size of a walnut. On cutting into the innominata from the aorta the aneurism was found to have originally extended from the origin of the innominata to its bifurcation. Both the cardiac and distal orifices of the subclavian artery, where the ligature was applied, were contracted, and the sides of the vessel adhered together so firmly that a probe could not be passed further along the canal than to within about a quarter of an inch of the distal extremity of the divided vessel. The right carotid was pervious and quite healthy. The parietes of the heart were thinner and softer than natural. The calibre of the aorta was not increased, but the coats had a deeper tinge of yellow than natural, were rather thicker and had a few small points of ossification. The lungs were healthy, contained a preternatural quantity of mucus, and the lining membrane of the bronchi was more than usually vascular.

Fig. 68.



(*a*) *the aorta slit open, in order to show the origin of the arteria innominata;* (*b*) *forming also the mouth of the aneurismal sac. The sac* (*c c*) *is laid open, in order to show the interior structure;* (*d d*) *a lamellated coagulum, which had consolidated the tumour;* (*e*) *the distal extremity of the subclavian, on which the ligature had been applied; it is laid open to show the obliteration of that vessel;* (*f*) *the right carotid;* (*g*) *the left subclavian, and* (*h*) *the left carotid;* (*i*) *the trachea;* (*k*) *the right clavicle sawn through.*

Such, indeed, were the results, and so satisfactorily did this interesting case prove the soundness of the principle on which this new mode of operating for aneurism was suggested, that the method was soon adopted both in this as well as in other countries, and has since been successfully resorted to in those cases for the cure of which neither the operation of Hunter nor that of Brasdor could be executed.

The next case in which an attempt was made to cure an aneurism by placing a ligature on only *one of the branches* of the diseased artery was under the care of Mr. Evans, an eminent surgeon, at Belper, in Derbyshire, and the result of the operation in this instance was still more satisfactory than in that of Mrs. Denmark, the aneurism being situated in the innominata as well as at the root of the carotid; and the ligature being applied on the carotid in place of the subclavian artery as in the former case[1].

An athletic young man, accustomed to laborious exercise, perceived, after a fit of coughing, a soft pulsating tumour about the size of a walnut, suddenly make its appearance behind, and extending a little above the right sterno-clavicular articulation, and covered, externally, by the sternal portion of the sterno-mastoid muscle. The tumour was greatly diminished by firm pressure, but could not be made to disappear entirely. Its pulsation was synchronous with that of the heart, was increased by pressure upon the right subclavian artery, and was *diminished* and sometimes completely arrested by pressure upon the right carotid. The pulsations of the right carotid and subclavian arteries were stronger than those of the left; but there was no apparent difference in the pulsations of the radial arteries.

Fig. 69.

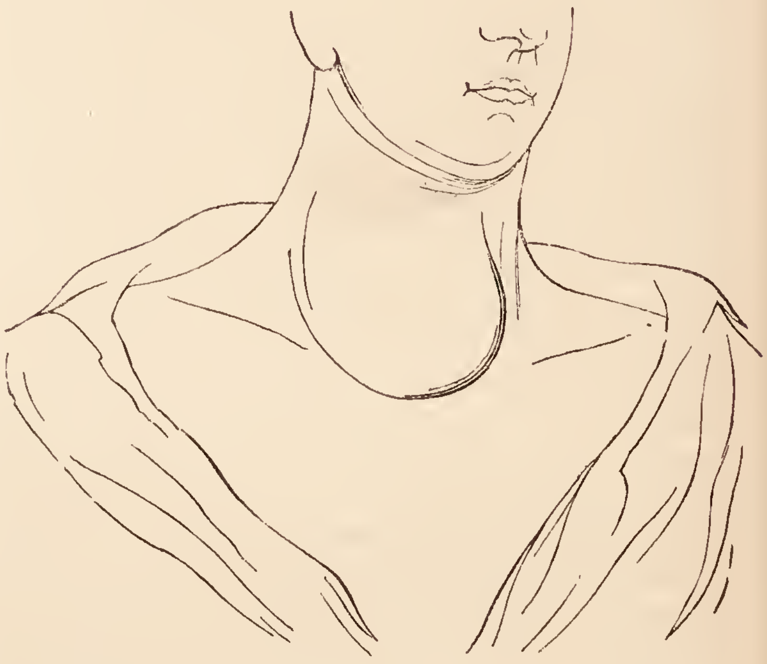


Fig. 69 *represents the form of this tumour.*

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[1] Lancet, 1828.

As soon as the tumour made its appearance, cough and dyspnœa, with which he had been some time affected, ceased to be troublesome, and his general health was soon re-established.

The situation of the tumour, its sudden appearance after a violent fit of coughing, and its soft pulsating character, led Mr. Evans to conclude that the root of the carotid artery was chiefly the seat of the disease. The patient was bled to the extent of eight ounces every third day, and he was enjoined to remain in bed and to live on small quantities of gruel, broth, and tea; small doses of digitalis were likewise administered. From this treatment there appeared some little improvement during the first month, but afterwards the symptoms increased, and finally the tumour reached as high as the cricoid cartilage, partially impeding both respiration and deglutition by its pressure on the trachea and œsophagus. His shirt collar, which, prior to his illness, could button comfortably, could not now be made to meet by upwards of three inches. His countenance became bleached, his pulse feeble, and it was considered that the depletive system of treatment had been carried as far as it could be with safety. Under these circumstances the operation of tying the carotid artery was performed. In consequence of the tumour extending so high up the neck, Mr. Evans found some difficulty in dissecting down to the sheath of the artery, which he laid open to the extent of half an inch; the vessel was easily secured by a single ligature of strong silk. Immediately after tightening the ligature the pulsations in the different branches of the external carotid ceased except a slight fluttering in the extreme branches of the temporal; but the pulsation of the tumour was not diminished. On the day following the operation the pulsation in the tumour was stronger than before the operation, and the pulsation of the radial artery of the right side was now more forcible than that of the left.

One of the most remarkable symptoms which afterwards occurred was *the obliteration of the arteries of the right-arm and fore-arm*, which change was first observed in the arteries of the fore-arm on the eighth day after the operation, for until that day the arteries of that arm pulsated with greater force than those of the left. This process of obliteration was attended with severe paroxysms of pain, chiefly felt in the course of the brachial and axillary arteries. The brachial artery, after its obliteration, was hard and painful to the touch; the arm wasted and became partially paralysed, and its bulk continued to diminish for three weeks, at the expiration of which period, several anastomosing branches were observed pulsating on the back part of the arm. As these vessels enlarged, the limb improved, though slowly, nor did it perfectly acquire its powers of motion and sensation until three months afterwards.

On the eleventh day after the operation the patient was attacked with paroxysms of pain in the right side of the head and face, which continued about a fortnight, and the pain was of the same character, though not so violent as he had experienced in the right-arm. The right side of the head and face at the same time became emaciated, and any one could immediately discover that the right half of the face was much smaller than the left. The blood afterwards found its way into the temporal and facial arteries, and the right side of the face then became nearly as plump as the left.

Three weeks after the operation he got out of bed, and then perceived that the whole of the right side was numbed and weaker than the left. The pulsation in the tumour, which had hitherto been more powerful than before the artery was tied, now began to diminish rapidly; and on the thirty-third day after the operation, it had so much diminished, that it was doubtful whether the swelling arose from the passage of blood into the sac, or from an impulse given to the tumour from the subclavian artery. In five weeks after the operation, he was sufficiently recovered to take exercise daily on horseback, and from that time he continued to improve in health and resumed his usual avocations.

Nine years have now elapsed since the operation, and I have learnt from Mr. Evans that this patient "continues to enjoy most excellent health, but that his right-arm has not yet recovered its usual fulness and strength though nearly so."

The *third* case of aneurism of the innominata, in which this mode of operating was adopted, was under the care of Dr. Mott, Professor of Surgery at New York, an account of which case I received from him along with the subjoined letter; the testimony and approbation of so distinguished an individual was at that time the more gratifying to me, as some persons, not satisfied with disputing the opinions I had advanced, endeavoured, for unworthy purposes, to impugn the veracity of statements which so many members of the profession, had ample opportunities of ascertaining to be strictly correct.

Sir,—With much pleasure I send you the accompanying case of Aneurism of the Innominata, treated by tying the carotid artery. It is the first of the kind which has been performed in this country, and I am persuaded that its success will be interesting to you, as additionally confirmatory of the great principle so ably and so fully established by yourself, which improvement must be numbered with the greatest in modern surgery; conferring upon the talent, genius, and acquirements of its advocate the highest honour and the most lasting fame.

As applied to aneurismal tumours, hitherto deciding the fate of the patient, and pronouncing him the certain victim of incurable disease, it must receive the approbation of the profession and the gratitude of the philanthropist. For the particulars of the case I take the liberty of referring you to the accompanying paper, and I am happy to present this account of the first operation performed in America for the cure of aneurism of the innominata, to the discoverer and first successful performer of it in Europe.

With sentiments of respect,
I remain, Sir,
Your obedient servant,
Valentine Mott.
New York, Feb. 15, 1830.

A farmer, sixty-one years of age, applied to Dr. Mott with a pulsating tumour about the size of a pigeon's egg, which extended some distance under the sternal and clavicular portions of the right sterno-mastoideus muscle, and as low down as the second rib. About three years before, whilst occupied in removing a building and compelled to lift heavy weights, he was attacked with pain in the upper and back part of the neck. The pain extended to the right shoulder and arm, and having continued during some weeks, then partially subsided, his voice at that time becoming hoarse. While shaving himself, about eighteen months afterwards, he discovered a small swelling at the upper part of the sternum, in which he felt a throbbing.

The tumour having now become very sensible to the touch, and respiration being impeded by the slightest pressure, its pulsations being synchronous with those of the heart, the tumour was considered as decidedly aneurismal. Dr. Mott advised him to avoid all exertion, to be occasionally bled, and to confine himself principally to vegetable diet. In four months the tumour above the sternum had much increased, the "bellows' sound" was distinctly heard, the thoracic viscera were healthy, and the respiratory murmur distinct throughout. By speaking, walking, or coughing, his respiration was very much impeded, and almost entirely suspended by the least pressure upon the tumour. The action of the right carotid was much more feeble than that of the left, and its branches did not pulsate. The right subclavian artery beat naturally, whilst the axillary and brachial vessels could scarcely be felt. No pulse could be felt at the wrist of the right arm.

Reflecting on this case, Dr. Mott was persuaded that the aneurism was situated in the *arteria innominata*, involving also the subclavian and root of the carotid arteries, and he considered it as a proper case for placing a ligature *on one of the branches* of the innominata. From the evident interruption of the circulation in the right arm, and the apparent efforts of Nature to effect a spontaneous cure, Dr. Mott determined first to tie the carotid, and afterwards to secure the subclavian artery, should it be required.

The carotid artery was secured in the usual manner, and on the following day the pulsation and size of the tumour were evidently diminished, and the breathing became more free. His voice improved gradually, and his cough and expectoration diminished. The ligature came away on the twenty-sixth day after the operation, the tumour above the sternum and pulsation having entirely disappeared. The wound soon healed, but a very considerable weakness of the arm remained, with slight œdema, and there was no pulse in the right radial artery. His breathing had become easy, the cough and expectoration much diminished, and he could sleep in positions which he had been unable to take for many months.

After the return of Moses Gardner to the country, he stated in one of his letters, that "his breathing was much better, and his friends were much struck at his improvement, particularly the disappearance of the tumour." On the 22d of April, however, I received information of his death. It appeared that the difficulty of breathing had returned, and threatened at times immediate suffocation.

"*Dissection.*—No tumour appeared externally; the right clavicle was a little elevated, and, on removing the integuments, was found partially dislocated from its sternal articulation, and a considerable portion of its under surface was absorbed. Immediately beneath, and imbedded in the surrounding parts, was the tumour, which extended from the sternal extremity of the left, to about the middle of the right clavicle, along the upper and inner surface of the sternum, and reached as low down as the third rib. Laterally it was adherent to the right lung, and posteriorly rested upon the lower cervical and upper dorsal vertebræ.

"The trachea was greatly displaced, and very much flattened by pressure of the tumour, to which also it was closely attached.

"The tumour was about the size of two fists, and its parietes were firmly consolidated. It emanated from the *arteria innominata*, involving the subclavian and root of the carotid. Superiorly it was of a globular form, but terminated, inferiorly, in a point which passed down below the division of the trachea, and behind the aorta. The right carotid was obliterated; the right subclavian beyond the tumour was pervious and natural in its structure; the heart and lungs were sound.

"The attending symptoms, as well as the dissection, fully prove the cause of death to have been the displacement of the trachea, and the consequent pressure of the consolidating tumour upon it and the bronchial tubes. Had the operation been performed at an earlier stage of the disease, there is every reason to expect it would have terminated successfully. Should I have another opportunity, I will operate without any delay, and tie both vessels at the same time, and not leave one for a future performance, to be decided upon by the effect of the first."

The *fourth* case of aneurism of the innominata treated according to this new method of operating was under the care of Dr. Morrison, of Buenos Ayres, and an account of it was first published in the American Journal of the Medical Sciences for 1837.

The patient, a man forty-two years of age, had a large pulsating tumour in the neck which extended upwards from within the thorax, and obliquely outwards behind the sternal extremity of the sterno-cleido-mastoid muscle. The tumour did not perceptibly diminish when pressure was made on the right carotid artery, but the pulse at the wrist of the right arm became fuller and stronger. When pressure was made on the right subclavian the impulse of the tumour was increased, as also the pulsation of the temporal and facial arteries of the right side. He had been chiefly confined to bed during the preceding nine months, labouring under pain in the cardiac region, difficulty of breathing, which was increased to a painful degree by walking, —rheumatism of the right shoulders and muscles of the neck, and hemicrania.

Concluding the tumour to be an aneurism of the innominata and right carotid, on the 8th of November, 1832, Dr. Morrison placed "a flat silk ligature on the *carotid artery*." In the afternoon, the patient complained of being much distressed "by hollow sounds in the right side of his head, and the pulsation in the tumour was so violent that they could be observed at some distance from the bed." The febrile symptoms were alleviated by repeated blood-lettings; and on the ninth day the tumour, which had become tender to the touch, began to pulsate more feebly, to become harder, and to diminish in size. The ligature came away on the thirty-first day, after which period he progressively recovered, and returned to his usual habits, which were those of very hard labour.

About nineteen months afterwards he complained of an oppression at the chest, with a slight cough, and in a month he died. On examination after death "the right subclavian artery was traced to its origin, at which place it was partially dilated. The arteria innominata was double its ordinary size, and studded with spiculæ of ossific matter. The right carotid artery, from its origin to the point where the ligature had been applied, was dilated into a sac, which was plugged up with a dense fibrinous deposit."

M. Laugier, an eminent French surgeon, operated upon the *fifth* case of aneurism of the innominata, in the year 1828[1]. The neck presented a pulsating tumour the size of a large hen-egg. It extended about two inches above the right clavicle, whose sternal extremity it had dislocated and pressed against the trachea, which was pushed to the left side. Outwards, it reached to near the middle of the right clavicle, and downwards about two inches from the top of the sternum.

These symptoms might have led to a belief that the subclavian and right carotid arteries were alone affected; but there was great reason to suppose that the innominata, and perhaps even the arch of the aorta itself, participated in the disease. The inclination of the trachea to the left side, the dull sound on the first and second ribs, where no tumour was perceptible; the difficulty of breathing; the peculiar resonance of the voice; the impossibility of feeling the termination of the tumour below the clavicle, joined to the consideration of the frequency of co-existent aneurisms of the innominata and aorta, were the principal sources from whence M. L. formed that diagnosis.

M. Laugier determined on taking up the *right subclavian artery* soon after it passes beneath the clavicle, and which he tied with a single silk ligature. No visible change occurred in the tumour immediately after the ligature was tightened, but on the following day it was evidently smaller, its pulsations were weaker, and the radial artery of the right side did not beat. The patient continued relieved, breathing better, and swallowing with less difficulty, until the seventh day after the operation, when a slight hæmorrhage took place of arterial blood from the wound. The bleeding returned several times, but ceased after the tenth day. On the fifteenth day, the patient perceived that the trachea was resuming its natural position, but he complained of pain in the shoulder and back, and was only able to sit with his body bent forwards, the pulse in the right wrist having then become sensible to the touch. Sometime afterwards, the tumour began to beat more strongly than before the operation, the cough and difficulty of breathing increased, and he died one month after the operation, the ligature still remaining in the wound.

On examination after death there was found a large aneurismal tumour of the arteria innominata, and the aorta was dilated. The sac was nearly filled with firm dense laminæ of fibrine; the lower part of the tumour containing more recently-formed coagula. The right carotid artery was completely obliterated from its origin to two-thirds of its extent, and presented several "singular valvular-like pseudo-membranes." The right subclavian artery was quite pervious to within an inch of where the ligature had been applied. The ligature had divided the artery, but was retained in the wound by a coagulum which had formed in its noose in consequence of the hæmorrhage. Besides, close to the capillary mouth of the artery there was a collateral branch of considerable size, which may have been the cause of the hæmorrhage, by preventing the formation of a sufficient internal coagulum. The third and fourth dorsal vertebræ were carious, and formed the parietes of the lower and back part of the aneurismal sac. Exactly in this situation the trachea was diseased, its inner membrane being thickened, discoloured, and its follicles very prominent. The œsophagus was here ulcerated, and communicated with the diseased vertebræ.

The next, and *sixth* case, was that treated by Mr. Fearn of Derby[1], and is one of much interest and importance. A female, twenty-eight years of age, had a violent fit of coughing on going into bed, and soon afterwards she felt a throbbing swelling above the sternum, which, for a few weeks, gave her a good deal of pain, and which was relieved by repeated bleedings. Five months after the commencement of this illness there was a rounded pulsating tumour observed in the neck above the sternum, bounded laterally by the trachea and tracheal margin of the sterno-cleido-mastoideus muscle. The "bellows sound" was heard in the supra-clavicular space, and a less distinct sound along the course of the right carotid artery. The pulse in the right wrist was very distinct. She complained also of a frequent cough and difficulty in breathing; each time the carotid was compressed the breathing became more tranquil, and when the pressure was removed the dyspnœa instantly returned;—a similar experiment on the subclavian artery did not at all affect the state of her breathing.

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[1] Lancet, 1828.

[1] Lancet, 1836.

The circumstance of the circulation in the subclavian artery being already considerably obstructed, and its entire obstruction adding to the distressing symptoms—and the further circumstance, that pressure on the carotid was followed by a relief of the dyspnœa, seemed to Mr. F. clearly to indicate, that for the cure of this aneurism a preference should be given to placing the ligature on the *carotid artery*. This he did accordingly by tying that vessel with a single ligature. A few hours after this operation the patient's breathing became a good deal oppressed, and she had many violent fits of coughing; but these symptoms were relieved by blood-letting and opiates: and they again several times recurred and were relieved by the same system of treatment. After the first eight days, a decided amendment took place in this patient's condition; the pulsation of the tumour diminished in force, its bulk was lessened, and the breathing was much more easy. At the expiration of a month the patient walked daily, her difficulty in breathing was entirely removed, and returned only when she walked fast. The tumour still continued to pulsate, but pressure upon it did not give rise to dyspnœa or any kind of inconvenience. In this state she returned home, no further treatment being deemed necessary.

Besides these six cases of aneurism of the innominata, which were treated by placing a ligature only *on one of the branches* of the diseased artery, two other cases are on record wherein a similar principle of operating was adopted. In one of these Mr. Scott placed a ligature on the right *carotid artery*, after which the aneurism somewhat diminished in bulk, but the tumour soon again increased, and ultimately proved fatal; however as there was no post-mortem examination, the real state of the vessels in this patient was not ascertained[1].

In the other case, a ligature was placed on the *subclavian artery* by Mr. Key, and the patient expired a few hours after the operation.

On reviewing the eight cases in which this operation for aneurism of the innominata has been performed, it therefore appears that in five of them a ligature was placed on the carotid artery, and in the other three the subclavian was the vessel on which the ligature was applied.

In five of the cases the operation was followed by relief of all the symptoms, and by a diminution of the bulk and consolidation of the tumour. The three other cases were unsuccessful; but this militates not against the principle of the operation itself, but the injudicious selection of the patients on whom it had been employed. In M. Laugier's patient the consecutive hemorrhage was a proof of the diseased state of the artery at the place where the ligature was applied, and the appearances after death pointed out that the operation in this instance, where the aneurismal disease was so extensive, was by no means judicious. Neither can the unsuccessful result in the case operated upon by Mr. Key, where the patient died a few hours after the operation, be considered as any proof of the disadvantages of this mode of operating, but of its misapplication; and in the case which was operated upon by Mr. Scott, there is every reason to believe that the aneurism was too far advanced, and the vessels too extensively diseased, to admit of any benefit from the operation.

In operating for aneurisms within the chest, it is of importance to remark, that the success of the operation will not depend altogether on the satisfactory effect of the ligature, and the consolidation of the tumour. Patients with a large aneurism, or even with one of no very considerable bulk, are often destroyed from the mere pressure of the swelling on parts essential to life; so that although the tumour be consolidated, the mere bulk of an unyielding mass may cause a multitude of distressing symptoms, and even prove fatal. In operating therefore for aneurisms of the innominata particularly, it is essential for this as well as for other reasons, that the tumour should not have attained a very large size.

It is in cases of aneurism of the *arteria innominata* that I consider the operation of tying one, or perhaps both, of the branches of that vessel, in an especial manner applicable; and in the application of this principle the first important point of inquiry ought to be, whether blood continues to circulate through both the carotid and the subclavian arteries, or through only one of these divisions of the innominata. I have already stated that there were some examples of aneurism of the innominata wherein Nature had shut up the carotid, and others wherein the subclavian was obstructed, and thus had, in part, accomplished the consolidation of the tumour.

When the aneurism has not attained so great a bulk as either to produce serious affections of the head or chest, or to threaten rupture, and when under such circumstances both the divisions of the innominata remain open, I would then be satisfied with first making a trial of Valsalva's system of treatment, in the hope that, ultimately, at least one of the vessels might be obliterated and the sac filled with concreted fibrine. Should however, so favourable a change not ensue, the propriety of tying one of the branches of the innominata is then to be considered; and it appears to me that such an operation ought to be unhesitatingly adopted in cases which would otherwise be hopeless. I may here observe, that it will perhaps be a matter of no small difficulty to ascertain when one of these arterial trunks is obliterated, and I as well as others have been more than once deceived on this point. Conceiving that a want of pulsation was a sufficient indication of the closure of an artery, I formed an erroneous opinion in the case of Mrs. Denmark; from the pulsation in the carotid and its branches not being perceptible, I supposed that the canal was plugged up; but in a short time after the ligature was placed on the subclavian, I was surprised to find the pulsations of the carotid return, and ultimately resume their wonted vigour.

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[1] Lancet, 1834.

It is a fact demonstrated by dissection, and worthy of remark in contemplating this mode of operating, that when a spontaneous cure of aneurism of the innominata has been going on, Nature has usually plugged up the carotid, so that in performing an operation for the cure of such an aneurism it would be advisable to imitate her in this respect, and to place the ligature on the carotid, in preference to the subclavian. The advantage of this practice is obvious, for as no vessels pass from the carotid between the ligature and the sac, a greater diminution in the force of the circulation in the tumour will follow than if the subclavian were tied, it not being practicable to apply a ligature on that vessel without leaving four large branches between the ligature and the sac. I have been taking for granted that the calibre of the carotid and subclavian was about equal.

Fig. 70.

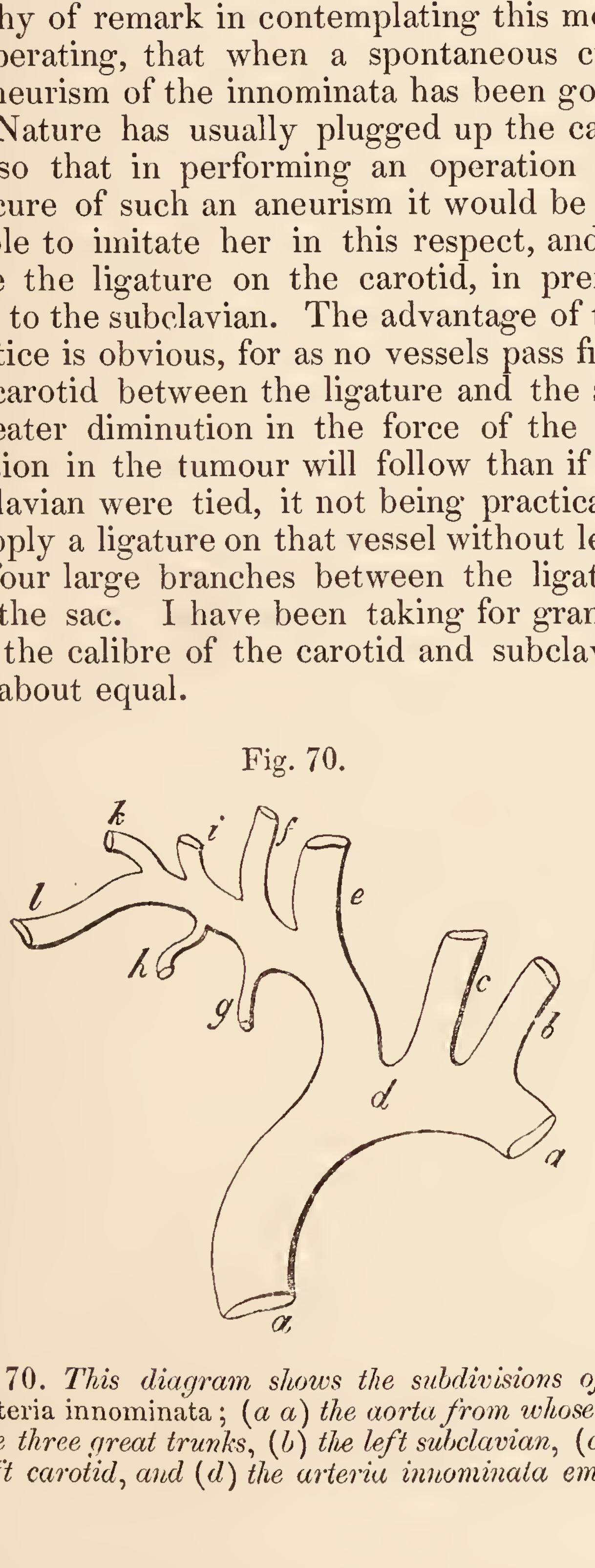

Fig. 70. *This diagram shows the subdivisions of the* arteria innominata; (*a a*) *the aorta from whose arch the three great trunks*, (*b*) *the left subclavian*, (*c*) *the left carotid*, *and* (*d*) *the arteria innominata emerge. The innominata* (*d*), *divides into two great branches; the right carotid* (*e*), *and the subclavian. The subclavian gives off five large branches before it emerges from beneath the scaleni muscles;* (*f*) *the vertebral artery;* (*g*) *the internal mammary;* (*h*) *the superior intercostal;* (*i*) *the thyroid axis;* (*k*) *the deep cervical; and* (*l*) *is the trunk of the subclavian, after it has passed beyond the scaleni muscles, and the point where the ligature is to be applied.*

In the practical application of this mode of operating for aneurism, it will be of great importance to be able to form an accurate *diagnosis* in aneurismal swellings of the neck, those particularly of the arteria innominata, and those at the roots of the carotid and subclavian arteries. Such diagnosis is generally considered extremely difficult; and erroneous opinions have in several instances been formed as to the site of such tumours by experienced surgeons. I apprehend, however, that the difficulty of distinguishing aneurisms of these different arteries from one another has chiefly arisen from the circumstance of their having been all considered incurable, at least by operation; and as far as the treatment is concerned, the same system being applicable to all of them, no one has endeavoured to point out their diagnosis.

Having had frequent opportunities of examining aneurisms at the root of the carotid and of the innominata, I think that tumours of these different vessels may be generally distinguished from one another; and the diagnostic characters I have chiefly derived from a consideration of the natural position of the vessels and their relative situation to the surrounding parts.

When an aneurismal swelling is formed at the *root of the carotid*, the tumefaction will first be perceived in the small triangular space formed between the heads of the sternal and clavicular portions of the mastoid muscle; and as the tumour increases in bulk, it displaces more or less, or sometimes produces the absorption of a portion of either the one or the other of the heads of that muscle.

If the aneurismal swelling be formed in the *arteria innominata*, then, in place of first making its appearance between the two heads of the mastoid muscle, at the bottom of which space lies the carotid artery, covered merely by a loose cellular membrane and some fat, the tumour rises up from below the sternum, and on the tracheal edge of the sternal portion of the mastoid, where the innominata is most uncovered. The situation of the tumour, however, varies according to the part of the artery that is affected; in one case, where the rupture of the internal coats of the innominata took place at the distal extremity of that vessel, the other coats yielding in the direction of the impetus of the blood, the tumour took a diagonal direction between the lines of the carotid and subclavian, and thus first appeared in the triangular space on the acromial edge of the mastoid muscle.

When the aneurism is formed in the subclavian artery, the tumour will rise on the cervical side of the clavicular portion of the mastoid, in the triangular space between that muscle and the trapezius, where, like the former vessels, the artery is covered only by some fat and condensed cellular membrane. It is, indeed, in these several spaces where the three different arterial trunks are most exposed, and where the superincumbent parts are of that nature which most readily yields to the growth of the aneurismal swelling.

Another diagnostic mark in aneurismal disease of these vessels is the state of the pulsation in the branches of the subclavian and carotid arteries; the force of the pulse being usually diminished in the branches of a trunk affected with aneurism. Thus, when the carotid is the seat of the disease, its branches only will have their pulsation affected; when the subclavian suffers, the radial artery will pulsate with less force; and when the innominata has become aneurismal, the circulation in the branches both of the subclavian and carotid will be more or less influenced.

I may also observe that in proportion as the anenrismal tumour acquires considerable bulk, the diagnosis will become more and more difficult, and the difficulty will, in many cases, arise from the circumstance, that two or more of these vessels, and in many instances the arch of the aorta itself, are involved in the disease.

In addition to these cases of aneurism of the innominata, aneurisms of other arteries have likewise been treated by placing the ligature on *one branch* of the diseased trunk. Sir Everard Home adopted this practice, and placed a ligature on the trunk of the common *femoral artery* in a case of aneurism of the external iliac[1]. But the operation failed, and he afterwards endeavoured to cure the aneurism by coagulating the blood within the sac by the application of heat. Dupuytren tested this mode of operating in a patient who had an aneurism of the subclavian, by placing a ligature on the *axillary artery;* but the case was not a favourable one for any operation, neither was the after-treatment likely to ensure a successful result.

"A husbandman, forty-five years of age, who had always enjoyed good health, experienced, without any assignable cause, a feeling of numbness and weakness in the whole extent of the right arm, and this was quickly followed by a painful sensation at the lower part of the neck, in the clavicular region. The tumour was constantly increasing in size, the arm became more numbed, and finally the numbness increased so much as to render his arm almost immoveable. Dupuytren at first tried Valsalva's method of treatment, combined with cold and discutient applications to the tumour, and though the patient had been bled seven times, and kept on a very low diet, still the tumour, instead of diminishing, continued to augment. The subclavian artery in the space between the scaleni muscles and the clavicle had acquired the size of an egg, and formed a tumour of considerable size outwards and upwards towards the trapezius. Below the clavicle the artery appeared healthy, but M. Sanson believed that the disease extended beyond that bone; the trunk of the common carotid appeared sound, but the strong and full pulsations of the commencement of the subclavian and of the innominata showed that both those vessels were likewise affected, although certainly to a less degree than the subclavian itself. The integument covering the tumour had not altered; the arm and hand of the right side were slightly œdematous; the hand was partly closed, and the patient could neither open it nor close it more. The whole of the limb was affected with great numbness and painful twitchings. The right arm was of the natural colour and temperature, and the general health good; the pulsations of the heart were strong and sonorous; the respiration easy; cough slight, but not frequent."

"Dupuytren conceived, that if the method of Hunter or Anel were admissible, it would be necessary in this case to apply the ligature on the origin of the subclavian, which itself was much affected, or on the trunk of the arteria innominata, which for the same reason could not be tied; besides the trials already made by MM. Mott, Græfe, and Lisfranc had not been sufficiently encouraging to lead one to perform the latter operation. There remained then but one alternative, either to abandon the patient to a certain death, or to treat him according to the method of Mr. Wardrop, and tie the *axillary artery.*

"M. Dupuytren performed this operation, and at the moment when the circulation was arrested by the ligature there occurred about twenty very strong pulsations of the tumour, which appeared for the time to augment in size, but very soon resumed their ordinary rhythm, and the patient felt very comfortable."

"On the following day the tumour was slightly diminished in size, and its pulsations less strong. On the fifth day there was some uneasiness, the pulse was stronger, and some paroxysms of cough having caused the tumour to swell, he was bled at the arm. On this day about noon, the compresses covering the wound were stained with arterial blood; he was again bled, and in the evening a third time, the discharge of blood continuing. On the next day the flow of blood was nearly stopped; bled in the evening to one 'palette.' The seventh day from the operation the patient appeared to be going on well, complaining only of debility and slight dyspnœa; bowels not opened since the operation; he takes every hour a small quantity of nourishment. On the eighth day the discharge of arterial blood again made its appearance, but in very small quantity: the tumour had much diminished in size; the limb was slightly tumefied, but preserved its sensibility, the dyspnœa, however, was slightly increased; the patient continued to get weaker, and died on the ninth day at four o'clock in the morning."

"On examination there were but few traces of the tumour; the pleura contained about a glassful of sanguineous serosity, but the left side contained more than the right; the left lung was healthy, the right covered with recent false membranes; it was slightly infiltrated, and the posterior portion of its middle and inferior lobes engorged, approaching to hepatization; the heart greatly dilated, its parietes appeared rather thinner, and almost resembling two leaves of parchment; and its substance pale. The aorta was much dilated and thickened, presenting on its internal surface large red patches; in other parts the internal membrane presented true ulcerations, of which some corresponded to osseous patches, others to a white and firm substance. This alteration terminated at the diaphragm. Traces of it were found in the arteria innominata, which was much dilated; also to a small distance in the common carotid and in the right subclavian in a more advanced state, the calibre of which vessel was equal to that of the innominata. The tumour rested on the first rib, the middle portion of which it had completely destroyed, the extremities of the bone projecting into the interior of the sac and covered by a fibrinous coagulum."

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[1] Philosophical Transactions, 1826.

"With respect to the operation, it had been as successful as possible, and had surpassed every thing which could have been expected: every thing went on well for the first days, and it is probable that if this slight hæmorrhage had not inspired alarm, and rendered the venæsections necessary in a patient who had already been bled seven times previous to the operation, he would have been able to have borne up against the slight affection of the left lung and that of the pleuræ; further, it is even probable, that these lesions only supervened during the latter period of the patient's life, when the organization, deprived of all its powers, no longer possessed means of resistance."

"This case is not then a failure (revers) for surgery; nor can it be cited as unfavourable to the method of Mr. Wardrop. M. Dupuytren stated, and with reason, that considering the death as the effect of the lesions of the thoracic viscera, and not as the result of the operation, he should not abandon, on this account, the method which he had employed, and which was the only one that could have been put in practice in such a case. He reminded persons that Sir A. Cooper had experienced the same failure the first and second time he placed a ligature on the carotid; that he himself lost the first patient in whom he employed the method of treatment for artificial anus; and he concluded by assuring those present that, in a similar case, he should act in the same way as he had done in this[1]."

Ligature.—Having considered the effects of artificially obstructing the passage of the blood through an aneurismal artery from placing a ligature on the vessel, on the cardiac or on the capillary side of the tumour, or on one branch only of the diseased artery, a most important inquiry, viz. the best mode of applying the ligature under any of these circumstances, still remains to be determined. Were it, indeed, practicable to apply a ligature on an aneurismal artery, so as to avoid all risk of consecutive hæmorrhage, the operations employed for the cure of external aneurism might be said to be perfect in all cases in which an operation would in other respects be advisable.

Various methods have been employed for applying ligatures on aneurismal arteries. In the old operation, in which an incision was made into the sac, the cardiac, and distal orifices of the diseased vessel were secured in separate ligatures. But since other modes of operating have been adopted, and it has been found requisite to cut down upon an arterial trunk, at a distance from the aneurism, with a view to obstruct the flow of blood through the vessel at that point, different means have been employed for placing the ligature on the vessel, the chief object being to lessen the risk of consecutive or secondary hæmorrhage.

The most simple method of employing the ligature consists in tying a single thread round the artery with sufficient tightness not only to interrupt the flow of blood through it, but also to cut its internal coats, and compress its sides, at the point of ligation.

Effects of its application.—When a ligature is thus applied on the trunk of an artery, a series of changes takes place, all which become necessary to secure the vessel from future hæmorrhage; and any of these changes, if not duly effected by the ligature, render the operation extremely hazardous and often fatal. The first effect produced by tying a thread tightly round an artery is to obstruct the transit of the blood through it. The circulation being thus arrested, that portion of blood, which is contained between the ligature and the first collateral branch on the cardiac side of the ligature, stagnates and forms a coagulum. This clot serves the purpose of a temporary barrier, and the inflammation, arising at the lacerated ends of the internal tunics of the artery, is followed by the effusion of coagulating lymph or fibrine. An adhesion is thus produced between the opposite sides of the vessel at the point of ligation. The coagulum of red blood is gradually absorbed, and replaced by a plug of concreted fibrine. Whilst this process is going on within the vessel, the ligature acting as an extraneous substance, and the noose having been drawn so tightly, as to destroy the vitality of the coats of the artery at the point of ligation, causes that part of the vessel to ulcerate, and thus allows the ligature to be separated. As soon as the ligature has come away, the wound of the parts, as well as the extremity of the artery, becomes covered with granulations, and ultimately the vessel is imbedded in a firm and condensed mass of cellular tissue.

The noose of the ligature may be either drawn so tight as only to bring the opposite sides of the vessel into close contact, or the inner and middle coats may be divided or lacerated by its pressure; and such division of the inner coats has usually been considered requisite to produce the necessary degree of inflammation of the tunics of the artery, as well as a sufficient exudation of fibrine to secure its closure, and the separation of the ligature. The moderate degree of force which is found sufficient to cut the internal coats of an artery in the dead body, and also in living animals, renders it probable that in the usual mode of applying the ligature, the division of the internal coats of the vessel almost always takes place; the degree of inflammation necessary for the closure of the vessel may, it is true, be produced without this division, but when the noose is tightly drawn, though it may create an additional risk of hæmorrhage, if the coats of the vessel happen to be diseased, it will secure an early separation of the ligature itself.

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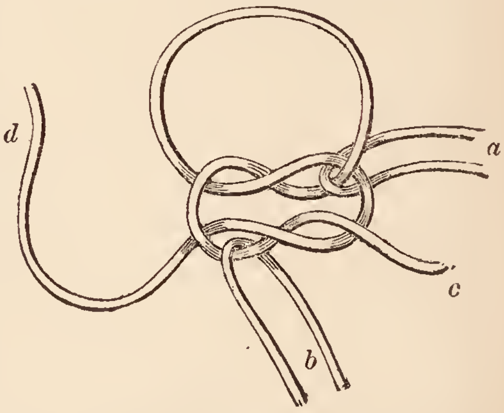
[1] Archives Générales de Médecine.

A temporary ligature has also been employed for the cure of aneurism. It had been ascertained, by experiments on animals, that when a thread is tied with sufficient tightness to lacerate the internal coats of an artery, and is allowed to remain on the vessel but a very few hours, an internal clot of blood is formed sufficient to oppose an obstacle to the circulation in the vessel, whilst a sufficient degree of inflammation subsequently ensues to produce adhesion of the coats of the vessel, and a permanent obliteration of its canal. In the few cases in which the temporary ligature has been applied on an aneurismal artery, the results have been such that the practice has not been generally followed; and even had the precise period necessary for the application of the temporary ligature been accurately ascertained, it would be still a matter of doubt whether or not there would in that case be less risk of secondary hæmorrhage, than when a permanent ligature had been employed; for as the force used in tying the ligature would in either case be the same, any risk of hæmorrhage from the artery being diseased at the point where it was tied, would be precisely the same in both cases. Moreover, the danger of hæmorrhage for want of sufficient space between the ligature and the nearest collateral branch to procure the stagnation and coagulation of a sufficient quantity of blood to form the temporary barrier, would be equal whichever of these modes had been employed.

The want of success which has hitherto attended the use of the temporary ligature, must not, however, be considered a conclusive proof of its principle being incorrect, but rather of the difficulty of attaining the object for which the temporary ligature is intended. It is evident that there must be a specific period, when a ligature applied in the ordinary manner must have effected all the good purposes that are required of it. Beyond that period, its longer detention in the wound cannot be of any use, and may be productive of much mischief. If, therefore, the ligature could be removed from the vessel immediately after the adhesion of its coats had taken place, and a coagulum been formed, without in any way disturbing the vessel, or interrupting the adhesive process that is going on in the wound, there would still be good grounds for employing a temporary ligature on an aneurismal artery. It appears to me that a plan suggested by Mr. Barker of Ipswich, for removing a ligature at any period that may be required after its application, is admirably calculated to accomplish this important purpose. By this plan, the surgeon has the power of loosening the knot of the ligature, by withdrawing a thread, without causing the slightest disturbance of the vessel. This is accomplished with a remarkable degree of facility, in the following ingenious manner:

The substance best suited for the ligature, is the common, small-sized cat-gut; two small loops of different coloured silk are also required. After the ligature has been conducted by the needle under the artery, one end of the ligature is passed through the first loop, *a*, and then the first noose of the knot is completed, and drawn with the usual tightness. The same end of the ligature is passed through the second loop, *b*, (fig. 71), and then the second knot is completed; that end of the ligature which is close to it, *c*, is then cut off. The edges of the wound being brought together, the two small loops and the long remaining end of the ligature, *d*, are to be brought out of the wound. Whenever it is desirable to remove the ligature, the surgeon commences by drawing one side after another of the second loop, *b*, in a see-saw manner. The noose of the knot will be thus speedily loosened, and the loop escapes out of the wound. The remaining loop is to be manipulated in the same manner, and the knot will be thus completely undone, and the ligature now lying loose in the wound, may be withdrawn with the greatest facility.

Fig. 71.



Another mode of employing the ligature has been to apply several threads at a moderate distance from each other along the course of the vessel. This expedient was had recourse to for the purpose of having at hand the means of controlling the flow of blood in the vessel, if the lowest ligature, which alone had been tightened, proved insufficient; but the practice has very properly been long since abandoned. Its impropriety will be at once felt, when we reflect, that the effect of a ligature is to excite a degree of inflammation in the vessel, which extends for some way, both above and below the point tied; while this process is going on, the coats of the vessel are more friable and unresisting than in the state of health, and if one or more ligatures are placed successively, one above another, while the artery is thus inflamed, the vessel is more easily cut through, and the consequences may be easily foreseen.

Another and indeed an ancient mode, which was advocated by Mr. Abernethy, consisted in the application of two ligatures, the artery being divided between them. To this mode of applying the ligatures, he was led by observing that secondary hæmorrhage was much more frequent after the operation for aneurism than after amputations; and he therefore anticipated that by placing two ligatures on an artery and dividing it between them, the upper extremity of the vessel, and which he erroneously supposed was the only one from which a secondary hæmorrhage could arise, would be, in this respect, precisely in the same circumstances as an artery tied after an amputation.

Of all these different methods which have been resorted to for placing the ligature on an aneurismal artery, that which is now almost universally employed in this country is the application of a single thread round the vessel in such a manner as to cause as little injury as possible to the adjacent soft parts, the noose being tied sufficiently tight to divide the inner coats of the vessel. There is, indeed, no operation which, if properly executed, is followed with more certain success than that of obliterating an arterial trunk by the application of the single ligature; how far such a procedure may be advisable for the treatment of particular cases of aneurism, is another point to determine: for in this, as in all other surgical operations, the ultimate success depends on the proper selection of the case, its previous treatment, and likewise on its after management. What I now contend for is, that if a single ligature be placed on an arterial trunk, the coats of which are healthy at the point of ligation,—if a sufficient space be left between the ligature and the first collateral branch for the formation of an internal clot; if the noose be made sufficiently tight not only to insure the adhesion of the sides of the artery, but also to cause a speedy ulceration of the coats to permit the escape of the knot; and above all, if this operation has been accomplished with facility and without detaching the vessel from its sheath and the soft parts contiguous to the sheath of the vessel to any unnecessary extent; and, finally, if the wound is not irritated after the operation by extraneous substances, this operation is almost invariably attended with success.

On reviewing the numerous cases of aneurism which have been operated upon since the Hunterian method was introduced, the cases in which it has been unsuccessful, have, in almost every instance, excepting those which were injudiciously selected for a surgical operation, failed from secondary hæmorrhage; whilst of late years, since important improvements have been made in the application of the ligature, and in simplifying the operation, the surgical treatment of aneurism can now be resorted to with great certainty, as far at least as regards the obliteration of the artery, whatever may be the changes effected in the aneurismal tumour.

To secure the success of the ligature, several circumstances are indispensable, besides those which relate to the mere application of the thread.

1st. No branch should come off from the trunk of the artery within a certain distance of the point of ligation, a space being necessary for the blood to stagnate and coagulate, and in which a fibrinous concretion may be ultimately formed, in order to produce a permanent barrier to the circulation. Whatever precautions may be taken, or however intelligent the operator may be, there is always a risk, either of some anomalous branch coming off close to the place where the ligature is applied, or the relative position of the parts may be so altered from the bulk of the aneurismal tumour, that the ligature is placed close to some collateral branch; and hence in either case, there not being sufficient room for the formation of an internal coagulum between such collateral branch, and the point of ligation, secondary hæmorrhage must follow whenever the coats of the vessel are ulcerated by the ligature. This accident has frequently happened when the operation has been performed on the trunk of the common femoral artery, in cases where the aneurismal tumour was so situated that there was not a sufficient space between the sac and the epigastric, or circumflex artery to permit the ligature to be placed, so as to leave a sufficient portion of the trunk of the vessel between the ligature and the origin of the branch for the formation of a coagulum.

2d. There should be no important deviation from the usual distribution of the vessel. When an anomaly occurs, we have to fear not only the danger arising from the ligature being applied too close to such a division of the artery, and preventing the formation of the necessary coagulum for its obliteration, but we have also to fear the continuance of the circulation on the capillary or distal side of the ligature. The more remarkable instances of these irregularities in the distribution of the arteries have been described by different authors, more particularly by Haller, Murray, Burns, Barclay, Tiedemann, Harrison, and Dr. Hennis Green, and will be referred to in describing the operations on particular vessels.

Mode of applying the Ligature.—There are certain points demanding particular attention when a ligature is to be applied on an arterial trunk, and which should be borne in mind, on whatever vessel the ligature is to be placed. The precise length of the incision in the integuments, after mature consideration, ought to be marked with ink. The length of the incision ought to be regulated according as the vessel may be more or less deeply situated, recollecting that the facility of the future dissection depends very much on a free incision having been made through the skin. The direction of the incision should not be exactly parallel with the line of the artery, but should cross it at an acute angle (fig. 72). This direction of the incision gives the operator the certainty of exposing the artery at one point of his incision; for if it be made parallel to the vessel, a difficulty may arise when the incision does not exactly fall upon the trajet of the vessel. The artery ought to be denuded as little as possible, and only at that point where the ligature is to be applied.

Fig. 72.

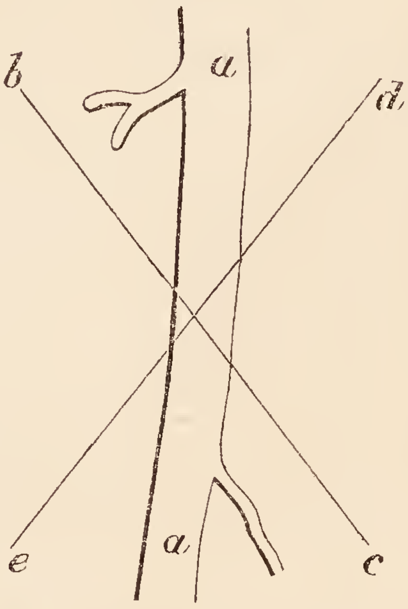


Fig. 72, *a a, an artery crossed obliquely by the lines of incision, b c, and d e.*

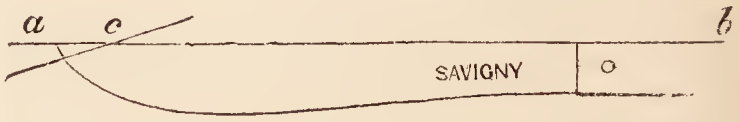
This mode of dividing the integuments offers essential advantages, not only in facilitating the future steps of the operation, but in affording the certainty of denuding the artery at one point, and only at that point where it is desirable the ligature should be applied. For if the operation be executed strictly according to this principle, the cellular sheath of the vessel will be exposed only to such an extent as to facilitate making an opening into it merely sufficient to admit the transit of a small needle for conducting the ligature round the vessel. The safety and success of the operation may indeed be justly said to depend on the ligature being applied without much disturbance to the soft parts contiguous to the artery, and likewise in the facility by which the needle is passed around it; and I am convinced that even the most experienced operators will find decided advantage in performing this operation, by adopting the oblique incision of the integuments which I have now recommended, instead of following the ordinary method of dividing the skin immediately above, and in a line parallel to the trajet of the artery; a practice which I am of opinion it will be better to avoid, even when operating on superficial arteries.

The advantages of marking the line of the incision with ink, before commencing an operation, should not be lost sight of, particularly in that of placing a ligature upon an artery. It frequently happens, that from the external incision not being of sufficient extent, the subsequent dissection is retarded, and it becomes necessary to extend the division of the skin, an inconvenience which can always be avoided by duly considering and marking the length of the incision beforehand.

The instruments necessary for dividing the integuments and performing the subsequent dissection, are, a scalpel, a directory, and a blunt-pointed knife.

The scalpel best adapted for this, as well as for most other operations, ought to have the back and handle made in one continued straight line, as represented in (fig. 73), *a b*.

Fig. 73.



By grinding a small portion from the back of the blade, at an oblique angle, a knuckle or projection *c*, is formed, which serves the purpose of guiding the sharp point of the instrument, the end of the operator's fore finger being applied upon it. With this instrument the incision is to be made down to the cellular envelope or proper sheath of the artery, and before attempting to open the sheath and expose the vessel, it greatly facilitates the operation to wait until the wound is cleansed from blood, when that is practicable; an assistant taking care to apply pressure on any bleeding vessel. The sheath of the artery being now distinctly seen, it is to be cautiously opened, conducting the scalpel by the director, and if this step of the operation be effectually accomplished, the aneurismal needle will pass with the greatest facility round the vessel; the cellular membrane, which lies between the artery and its sheath, being remarkably loose, yields readily even to a blunt-pointed instrument. If the artery be so deeply situated that it cannot be distinguished by the eye, the opening of the sheath is a step of considerable difficulty and great nicety; the difficulty consisting in ascertaining with certainty, that the sheath is opened. It is here that the form of scalpel which has been recommended would be found particularly useful, and the sharp point safely guided by the finger of the operator. In order to be assured that the sheath of the vessel was opened, when I had no means to ascertain it but by the sense of touch, before venturing to introduce the needle, I have always passed within the sheath a blunt-edged silver knife, with its point slightly curved, after which the aneurismal needle may with confidence be introduced. This step of the operation will be more safely and speedily accomplished by passing the needle between the artery and its accompanying vein or from within outwards, than from without inwards. By this mode of proceeding, there is much less chance of including the vein along with the artery within the ligature, an occurrence which I have known happen to experienced surgeons. The needle for conducting the ligature has been made of a variety of forms, and several different contrivances have been resorted to, to convey the ligature round deep-seated arteries. The most simple, and by far the most preferable aneurismal needle for general use, is of a curved form, somewhat like the letter S. (See Ligature.) When of this shape the point can be passed in various directions, and carried round a vessel of considerable depth.

The needle ought not to be so thick as those usually employed; and whilst its point should not be so sharp as to endanger a wound of the artery, it ought not to be so large or so blunt as to prevent it being easily slipped round the vessel. Neither should the eye of the needle be too near the point, so that when the ligature is in it, the needle may not be interrupted in passing through the loose cellular membrane between the artery and its sheath.

The best ligature which can be employed is the common silk thread used by dentists, and a noose formed by a single knot is to be firmly drawn, guarding against pulling it so tightly as to lacerate the cellular coat of the artery. Due care should be taken before tying the ligature, that nothing be included in the noose but the denuded artery, and that the coats of the vessel are in a healthy condition; and as it is of great importance, to diminish the risk of consecutive hæmorrhage, that a sufficient portion of the vessel be left between the ligature and the first inosculating branch, it is safer to tie the vessel at the farthest point which is denuded, than at that nearest the heart, by which means a larger space will be left in the vessel for the formation of an internal coagulum. The ligature having been tied, the ends of the thread may be either left in the wound, or one of them may be cut off, or both may be removed close to the knot. As it is essential for the success of this operation, that the wound be speedily healed, in order that the soft parts contiguous to the vessel may be consolidated, the small ligature is decidedly preferable, its presence causing less irritation, and, for this same reason, cutting off one of the threads will still further diminish the irritation arising from the presence of an extraneous body within the wound. (*Veitch.*)

In order still further to remove all causes of irritation in the wound, both ends of the ligature have been cut off, and this is, perhaps, all things being considered, the most preferable mode. When nothing remains in the wound but the noose on the artery, all the soft parts which had been necessarily divided in order to reach the vessel and pass the ligature round it, may be brought into close contact and retained in their natural position; so that, except the very limited spot where the noose of the ligature remains, the whole of the wound will be readily united by adhesion; and it is found from experience that the noose of the thread is ultimately discharged by an orifice formed in the cicatrix. (See LIGATURE.) The separation of the noose takes place at very different periods after the operation, according to the kind of ligature employed, the force with which it has been tightened, and the degree of local excitement that follows its application; but no further degree of inflammation and suppuration supervenes than what is necessary for the displacement and discharge of the ligature, and it is of advantage that the ligature should not be separated until the canal of the artery be permanently obliterated.

The consecutive treatment. — The wound should be dressed in the most simple manner; all the blood on its surface ought to be carefully removed, and the divided parts ought not to be brought together until the bleeding has completely ceased. The edges of the wound are then to be kept in contact by short strips of adhesive plaster, either with or without a few stitches; and a bandage, when the operation has been performed on one of the limbs, may be applied, but only with a very moderate degree of firmness,—or bandages may be dispensed with altogether. All circumstances being favourable, the whole of the wound will heal by adhesion, scarcely any after-dressing being necessary; and the noose of the ligature will be discharged in fifteen, twenty, or sometimes a greater number of days, unattended with any pain or inconvenience.

A series of changes take place in the vascular system, immediately on the application of the ligature, whether placed on the cardiac or on the capillary side of the aneurism, or on one of the branches of the diseased artery. The pulsations in the tumour either cease altogether, or a thrill more or less distinct may be perceived, and its bulk diminishes in proportion to the thinness of the walls of the sac. But as I have already explained (see ANASTOMOSIS), the circulation in the trunk of an artery is no sooner interrupted, than the anastomosing branches increase in size, to supply those parts with blood which had been nourished by the obstructed vessel. Hence, immediately after the application of the ligature, the inosculating vessels beat with an increased impulse, and, if situated near the surface, they may be seen to enlarge, as is well illustrated in the branches of the temporal and occipital arteries, when the trunk of the carotid is obstructed by a ligature.

A like diminution in the bulk of an aneurismal tumour is produced when the ligature is placed on its capillary side, or when only one of the branches of the aneurismal artery has been secured. In all cases where either of these modes of operating have been employed, it has been distinctly noticed, that a very considerable diminution in the bulk of the tumour took place immediately after the ligature had been applied on the diseased vessel.

When the patient has been subjected to a rigid system of preparation before the operation, it may be anticipated that no circumstance will ensue to interrupt the progress of the cure, the operation causing little or no disturbance of the general system, the tumour gradually becoming consolidated, and the limb being properly nourished by the enlargement of the collateral vessels. Until such a favourable result of the operation is produced, it is of primary importance, not only that the limb but that the whole frame should be kept in a state of perfect repose; the strictest attention should likewise be paid to regulate the patient's diet and keep his mind tranquil. The limb should be kept moderately warm, and whilst all cold applications ought to be avoided, it is equally proper to guard against too much heat and the application of stimulants to the limb. Unless interrupted in its efforts, the economy is active in restoring the collateral circulation; so that if from the application of heat or stimulants the vascular system be too much excited, inflammation of the wound or congestion of the limb may take place. The diet should be mild, and merely sufficient to allay the sensation of hunger, and the bowels ought to be regulated by mild laxatives or enemata.

With whatever facility the operation may have been performed, and, however favourable the circumstances may have appeared to be when it was undertaken, yet it is sometimes followed by a train of severe symptoms, either in the parts on which the operation has been performed, on the aneurismal tumour itself, or on the system generally. In some individuals the ligature of a large artery is succeeded by a greater or less degree of excitement of the whole system,—the pulse becomes full and hard, there is an increased heat of the skin, and perhaps, too, uneasy sensations are excited in the wound, in the tumour, or in some internal organ. In this state, the chief means to be relied on, are the abstraction of blood, sudorifics, laxatives, and such medicines as tranquillize the action of the heart. The quantity of blood to be taken can only be determined by the changes in the pulse which take place during the flow of the blood from a vein, and the blood should be allowed to flow until the pulse be subdued, the impulse of the heart diminished, or until a state of approaching syncope is produced. Should the large intestines not have been duly evacuated, an enema should be exhibited. One grain of calomel, taken singly or combined with three grains of James's powder, may be given every four, six, or eight hours alternately with a small dose of saline medicine, or the common saline draught, according to the violence and duration of the febrile symptoms. As in cases where any considerable degree of excitement has supervened after the operation, one bleeding is seldom sufficient to subdue permanently the febrile symptoms, the impulse of the heart and the pulse ought to be carefully watched, and when they rise again above their natural standard, or should there be any degree of local pain, whether in the tumour, or in the wound itself, under any of these circumstances the bandage ought to be replaced on the arm, and the blood allowed to flow until the increased action of the heart be again subdued. After the febrile state of the system has been combated, as far as can be effected by depletion, any immoderate action of the vascular system which remains may be allayed by the exhibition of the tartrate of antimony, opium, or colchicum. This depletive system may indeed be pursued with the greatest confidence, recollecting the important fact I have formerly mentioned, that a languid state of the circulation, caused by the abstraction of blood, instead of preventing, essentially contributes to the rapid deposition of fibrine within the canal of a divided artery, or within an aneurismal sac. Hence a patient, on whom an operation for the cure of aneurism has been performed, cannot, to ensure its success, be too much depleted, as far at least as regards the obliteration of the artery at the point of ligation, and strengthening the walls of the sac by the formation of concreted fibrine.

Sometimes a limb becomes cold after a ligature has been placed on its main trunk. This seldom continues more than a few hours, and nothing is requisite but to keep it covered with some cotton or silk, taking care that it is so supported and covered, that no considerable degree of pressure be allowed to bear on any particular part. But if the coldness of the limb continues for a lengthened period, further means must be employed to restore its natural temperature, such as placing bottles of hot water, or flannel bags filled with heated salt, in the vicinity, but not too near the limb. Sometimes a cold state of the limb is succeeded by an increase of temperature above the natural standard; and even with such a degree of congestion as to render it necessary to apply leeches, or even to take some blood from the arm.

It sometimes happens, after either of the different methods of operating for aneurism has been employed, that sooner or later, even in a very few days, the aneurism regains its former size and again pulsates; a circumstance which may occur from a collateral branch arising from the artery between the point of ligation and the sac, carrying on the circulation through the tumour; or some branch communicating with the aneurismal artery on the capillary side of the sac, may, in like manner, cause a stream of blood to flow through the tumour. But whatever be the cause of the circulation being maintained in an aneurismal sac, it has been already pointed out, that a complete stoppage of the blood's current is not necessary to secure the success of the operation. It is only requisite to procure the formation of fibrinous laminæ within the sac sufficient in thickness to secure its walls against the impetus of the blood—an effect, which, in the cases alluded to, is produced by the very languid state of the circulation, which continues in an aneurism after a ligature has been placed on the trunk of the diseased vessel, rendering much resistance of the parietes of the sac unnecessary, and by the same languor of the circulation likewise promoting the effusion of fibrine within the cavity of the tumour. A moderate degree of compression upon the tumour, will, in most cases, suffice to procure the cessation of this languid flow of blood through it.

An aneurism may not only continue to pulsate but to increase in size after the operation. In such cases, inflammation, suppuration, and sloughing of the tumour supervene. The coagula within the sac are discharged, the suppurating cavity is filled with granulations, and if the patient's health can support the discharge, cicatrization of the wound, and a perfect cure of the disease, may take place. Hæmorrhage under such circumstances rarely occurs, both extremities of the arteries being plugged up with fibrine, in the same manner as blood-vessels are found in the neighbourhood of mortified parts.

In the records of operations for aneurism, a considerable number of cases will be found where the limb has mortified; and this may have been occasioned either from some obstruction to the collateral circulation, or in some cases from the large bulk of the aneurism, causing a stagnation of blood in the smaller vessels, and capillaries. In general, however, when gangrene does occur, it is limited to small portions of the extremities, the fingers or toes, for instance, or the parts that have been too much subjected to pressure. Phlyctenous patches, followed by circumscribed eschars are also sometimes observed. The limb, under these circumstances, is benumbed, its sensibility is blunted, or a pricking sensation is felt more or less extensively. If the gangrene be limited, the sloughs are detached, and the sores heal, according as the collateral circulation becomes more and more fully established. When it extends to the whole limb, the surgeon should wait till its ravages are fairly circumscribed, before resorting to amputation.

But by far the most alarming event which can happen after the operation, is *hæmorrhage* from the wound, an event which may in general be averted, but which, when it does occur, is fraught with danger. The numerous methods which have been attempted to improve the mode of applying the ligature, have all had the important object in view of diminishing the risk of secondary or consecutive hæmorrhage, and in the present advanced state of surgery, if a judicious treatment of patients previously and subsequently to the operation be duly attended to—if the case be a proper one for adopting the measure, and the operation in all respects well executed; under such favourable circumstances, there will be little danger of secondary hæmorrhage. It may happen, however, that, from some constitutional peculiarities which could not be foreseen, the wound does not heal by adhesion, but suppurates, sloughs, and exposes the artery to ulceration; or the coats of the vessel may not be in a sound state, and will not adhere at the place where they are brought into contiguity by the ligature, so that when it comes away, hæmorrhage ensues, or, what is the most serious of all accidents, the noose may happen to be placed so close to a collateral branch, that there is not sufficient room for the blood to stagnate and coagulate for forming a plug to stay the current of the blood. From any of these causes a hæmorrhage may ensue; the blood may flow either from the cardiac or from the capillary orifice, or it may occur from both at the same time. When the blood flows from the capillary orifice, it issues with much less impetuousity, and the blood itself has much more the appearance of venous blood than when it bursts from the cardiac orifice.

A vigorous depletive system will, I am convinced, in most cases, ensure the healing of the wound by adhesion; but when suppuration does take place, whether from such depletion not having been properly attended to, or from the soft parts around the artery having been too much displaced and injured by the operation, every effort should be made to promote the growth of healthy granulations in the wound, by the ordinary local treatment, as well as to correct, as far as possible, any disturbance of the general health. Above all, essential benefit may, under such circumstances, be derived from the use of either of the sulphates of quinine or iron, and the mineral acids; the nervous system ought to be soothed and the circulating organs tranquillized with colchicum and narcotics.

If, from the progress of the ulceration in the wound generally, or of the artery at the place of the ligature, a hæmorrhage actually takes place, serious apprehensions may be entertained of the result of the operation, and the treatment to be adopted requires the greatest promptness and decision. The first impulse of the bystander, when a jet of blood comes from the wound, is to employ pressure, and, if the wound be sufficiently large to admit the finger, the most manageable and effectual mode of applying it, is by placing the point of the finger, either with or without a small thick dossil of lint, on the bleeding orifice, employing only such degree of pressure as is necessary to arrest the hæmorrhage until further means can be obtained. If the blood flows from the capillary orifice, a much less degree of pressure will be found necessary to stem it, than when it flows from the orifice on the cardiac side of the ligature. The moment the flow of blood is controlled, all dressings and bandages should be dispensed with, and the trunk of the patient's body exposed to a cool, though not chilling air. Mental tranquillity is almost equally as essential, the slightest mental emotion increasing the action of the vascular system. Hence all appearances of fear and alarm ought to be particularly guarded against by the attendants, and a large dose of opium, alone or combined with calomel, should be exhibited. The subsequent means to be employed, those which have for their object permanently to arrest the bleeding, are now to be considered, and these must be modified according to the cause of the hæmorrhage, as well as to the particular vessel on which the operation has been performed, and likewise to the orifice, whether the capillary or the cardiac, from which the blood may have made its escape. If the hæmorrhage has been caused by a collateral branch betwixt the aneurism and the heart, preventing the formation of a coagulum or internal clot of sufficient length to plug up the canal of the artery above the ligature, then it may be advisable to place an additional ligature on the artery, between the collateral branch and the heart, provided such a measure be practicable from the seat of the aneurism, and likewise from the superior part of the vessel not having another collateral branch so near as to render it injudicious to resort to a second operation. When, for example, a ligature has been placed on the trunk of the common femoral artery, I have known hæmorrhage to take place in consequence of the proximity of the noose of the ligature to the circumflex ilii, and epigastric arteries, there not being sufficient room left for a coagulum to be formed between the ligature and these branches; in such a case the patient's life can be saved by securing the external iliac. In one case, an experienced surgeon tied the superficial femoral artery close to the profunda, intending to place the ligature on the common trunk of the femoral artery—and the patient died from hæmorrhage. The same error was committed by another surgeon.

When secondary hæmorrhage has arisen in consequence of the diseased state of the coats of the artery at the place where the ligature was applied, preventing their adhesion, and causing their ulceration, then it may also be considered, how far it may be worth while to risk another operation, and place a second ligature on the artery at a place where its coats are supposed to be sound. In other cases of a similar description, the propriety of amputating the limb, if such a proceeding be practicable, may be duly considered, and should be resorted to, when it can hold out a rational prospect of saving life.

If secondary hæmorrhage has been caused by a bad condition of the wound, and the ulcerative process has extended to the artery, then art can avail but little, and we must entirely confide to a well-directed pressure with the point of the finger on a small compress of lint, on the bleeding orifice, effected by a succession of competent assistants, along with the application of styptics, of which the most powerful is the saturated solution of alum, sulphate of copper, or the lunar caustic.

TRAUMATIC, OR FALSE ANEURISM.

The false, spurious, diffuse, or traumatic aneurism, consists in a tumour, formed by effusion of blood from a wounded artery into the surrounding cellular membrane. This species of aneurism is usually caused by the arteries being wounded by a sharp pointed instrument, the limb being pierced in an oblique direction, so that the opening in the artery not corresponding with that of the integuments, the blood, instead of escaping through the external wound, is infiltrated into the cellular membrane, adjacent to the wound in the vessel. A false aneurism has also been in some cases formed by the fractured extremity of a bone wounding an artery; or the violence of the injury which caused the fracture, may produce also the rupture of the parietes of the artery. It has likewise been known to succeed violent muscular efforts, producing a sudden rupture of arteries, the tunics of which had been previously diseased. The effusion of blood, which arises from a ligature cutting too quickly through an artery, falls also under this designation; and even the term *false* has been applied to the second stage of the true aneurism, when a rupture of the sac has taken place. Sometimes the effusion of blood immediately follows the wound of the artery, and is diffused in an irregular manner among the soft parts; at others, the effused blood is contained in a circumscribed cavity or sac, formed also by the surrounding cellular membrane, or by the proper sheath of the artery. In the former instance, the false aneurism is said to be *diffused;* in the latter, *circumscribed.*

If the wounded artery be deeply seated, and underneath a strong aponeurosis, and the external wound is narrow, oblique, and not corresponding with that in the artery, no great hæmorrhage may take place at the time of the accident, the blood coagulating and forming a clot which prevents the bleeding. In a few days, however, the limb swells, the tumefaction commencing at the wounded part, and extending more or less gradually in different directions over the member, and this circumstance, together with the situation, direction, and depth of the wound, generally leads to the detection of the real nature of the injury.

When arteries superficially situated are wounded, ineffectual attempts to heal the wound by the application of pressure, may cause the formation of a false aneurism, by preventing the blood from making its escape through the external wound, and allowing it to be infiltrated in the surrounding cellular membrane; or the wound in the soft parts, in consequence of some movement of the limb, may be drawn away from the corresponding orifice of the artery, or the swelling of the soft parts may prevent the escape of the blood by the external wound, and thus cause it to be diffused more or less extensively amidst the surrounding parts. Sometimes a false aneurism increases at intervals; the clot of blood which had temporarily closed up the wound of the artery being detached by the force of the circulation, and thus permitting further effusion of blood. In this manner, all the parts around and below the wound become more or less speedily injected with blood. When the distension of a limb is very great, the return of the venous blood becomes impeded, and hence follow œdema, coldness, and diminished sensibility of the member, and if the integuments are greatly distended, gangrene supervenes, and extends throughout the limb, or abscesses may be formed, followed by profuse discharge of pus, and the separation of gangrenous eschars.

An aneurism arising from a wounded artery, sometimes, though rarely, undergoes a spontaneous cure; but when it does occur, the curative process is effected, as in the true aneurism, by the formation of a coagulum within the sac; and if the wound of the artery be allowed to close, or if the aperture be of greater extent and the tumour of larger bulk, the canal of the artery may be completely obliterated.

The *treatment* to be employed in cases of this kind will depend on the extent of the wound, the size of the artery, and the duration of the disease. When an artery has been merely punctured, as sometimes happens in the operations of phlebotomy and cupping, a very moderate degree of pressure, made by means of a small but thick compress placed upon the wound, will be sufficient to prevent the outpouring of the blood, and to keep the edges of the wound in contact.

If, from a similar accident, a tumour has formed by the effusion into the cellular membrane surrounding the artery, compression may be successfully employed, provided that the blood within the tumour be evacuated before the compress is applied.

It is only, however, in aneurismal swellings, caused by very small wounds, or in large wounds of the smaller arteries, that compression can be successfully employed; indeed, when ineffectual, it is often followed by bad consequences, such as inflammation of the wounded soft parts adjacent to the artery, and extensive suppurations, which render all further local means to stop the bleeding abortive; and the patient's life can be saved only by amputation of the limb, if from the site of the wound such a measure be practicable. All the other means which have been recommended for the cure of the true aneurism, by promoting the coagulation and consolidation of the tumour, ought here to be also employed.

Before resorting to more severe measures, the hæmorrhage from a wounded artery may sometimes be arrested by pressure, applied upon the bleeding orifice with the point of a finger; and if it does not succeed, pressure employed on so limited a space, and so well regulated, can never be followed by any of those bad consequences which are produced by the pressure of bandages and other mechanical contrivances. There is indeed little difficulty in applying pressure with the finger on a wounded artery in such a manner as shall cause a temporary cessation of the hæmorrhage. The external wound, if not sufficient to admit the introduction of a finger, must be enlarged, the coagula of blood infiltrated in the cellular membrane carefully removed, and when the precise site of the wound of the artery is ascertained, pressure is to be made upon it with the point of one finger, sufficient to check the bleeding, and this is to be continued hour after hour, or even for days, by employing a succession of assistants, till the risk of hæmorrhage is permanently removed. In this manner I have succeeded in stopping the bleeding from a wounded artery of very considerable size, when, from its site and other circumstances, it would have been a severe and hazardous operation to have secured the bleeding orifices with ligatures.

At the same time that compression is employed to arrest hæmorrhage, it ought to be remembered that the formation of a temporary barrier to the flow of blood, and the subsequent adhesion of the wound, are materially promoted by a languid state of the circulation, a state which can always be induced in a requisite degree, by the abstraction of blood, or by the influence of the tartrate of antimony on the action of the heart.

When these means have failed in curing the disease, one of two operative proceedings may be now adopted, the sac of the aneurism may be freely laid open, and the two orifices of the wounded artery tied with ligatures, or a ligature may be placed on the trunk of a vessel, at a distance from the wound. To the first of these modes of operating there are several serious objections; the infiltration of the cellular membrane with blood, the displacement and sanguineous discoloration of the soft parts, and the depth of the wounded artery, while they render the operation, in many instances, extremely difficult, affect also, in a serious degree, the patient's chance of recovery; for the parts adjacent to the wound have already become inflamed, the patient's mind has been greatly excited by the circumstances attending the accident, as well as the nature of the injury, and his constitution may have sustained a great shock by a succession of harassing bleedings from the wound, and painful attempts that may have already been resorted to, for the purpose of arresting them. When the artery is superficial, it will, however, in general, be best to expose it and place a ligature both above and below the wound.

Some surgeons think that this proceeding should be adopted wherever the situation will admit of it, even when the vessels to be tied are deep-seated. Dupuytren, on the other hand, thinks that a single ligature, placed on the cardiac side, will be sufficient in most instances, especially if assisted by compression, except where the anastomosing vessels are large and numerous.

The other mode of proceeding consists in placing a ligature on the trunk of the artery on the cardiac side of the aneurism, and at as great a distance from the tumour, as the particular case will admit of. Whenever this mode of operating for false aneurism is practicable, it offers the same advantages as are to be derived from the Hunterian operation in cases of true aneurism. But arteries are occasionally wounded where it is inexpedient to tie the trunk of the vessel, as, for instance, the gluteal, and, in such cases, it becomes necessary to adopt the first mode.

It is a point of great importance, however, before any incision is made to expose the wounded vessel, that the surgeon should take the proper steps to enable him to command the hæmorrhage during the operation.

Some doubt has been entertained as to the course which it may be best to pursue with regard to the extravasated blood: some surgeons being of opinion that it ought to be evacuated through incisions made for the purpose; others, that it should not be interfered with. It is scarcely possible to decide the point in a general manner. Small effusions may safely be left to themselves; and in large ones, the admission of air may be attended with the worst effects. The urgency of a case, however, may now and then be mitigated, and the excessive tension relieved by a partial evacuation of the effused blood, especially if it should be accumulated at one point. The practice, however, is full of hazard, and even though the wounded vessel should have been secured, affords but a slender chance against the supervention of gangrene, or the necessity of amputation.

(*James Wardrop.*)

VARICOSE ANEURISM.

In this form of aneurism, which is a variety of the traumatic, both a vein and artery are wounded, and a communication is thus established between them.

There is some confusion in the application of this term. By some it is taken as referring to the tumour which is sometimes formed between the wounded artery and vein; the term *aneurismal varix* being applied to the dilatation of the vein. This confusion of terms, is, however, easily avoided, the accidental intermediary tumour is simply a circumscribed false aneurism, while the dilatation produced by the diversion of the arterial current into the vein, constitutes the *varicose aneurism.*

This affection can only occur where a vein and artery of some size lie close together. It is observed most frequently at the bend of the arm, and is produced in the following manner; in the operation of phlebotomy, the surgeon, from want of due care in ascertaining the position of the brachial artery, and its relation to the vein which is to be opened, not only carries the point of the lancet through both sides of the vein, but punctures the subjacent artery. The arterial blood finds an exit through the wound, either into the surrounding cellular membrane, forming a false aneurism, or it may pass directly into the vein, forming the varicose aneurism (see fig. 74): or again, the circumscribed false aneurism of the artery may communicate with the posterior wound of the vein, in which case, a circumscribed false aneurism, and an aneurismal varix or varicose aneurism co-exist.

Varicose aneurism may, however, be produced in a variety of ways. Mr. Hodgson relates two cases, one observed by himself, in the ham, which had been caused by a pistol-shot; the other, communicated to him by Mr. Barnes of Exeter, in which the femoral artery and vein were wounded about four inches below Poupart's ligament, by the point of a heated iron rod.

Fig. 74.

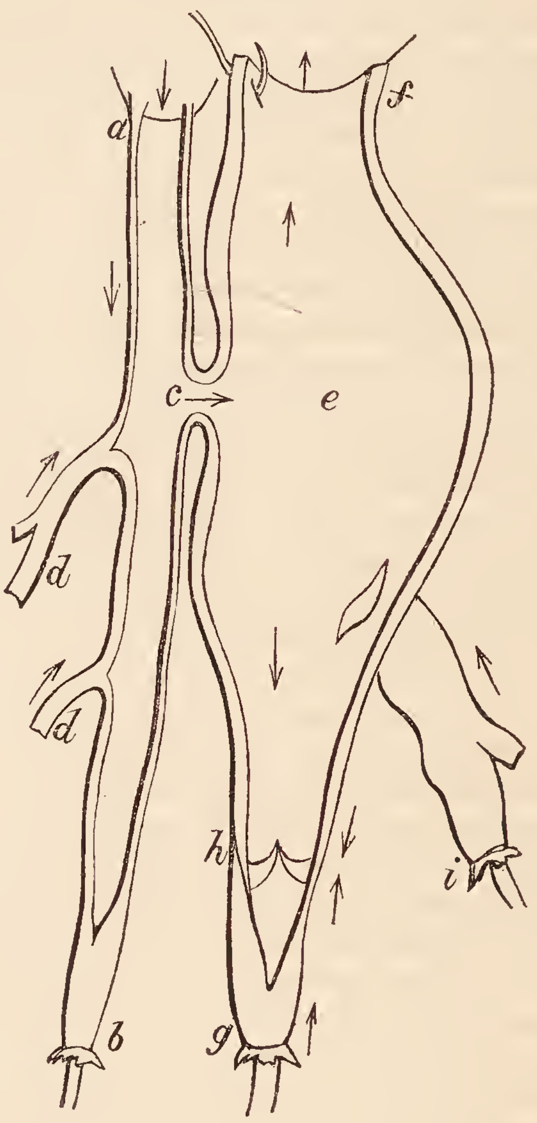


Fig. 74 *presents the preparation of a varicose aneurism of the brachial artery, which had been caused by a wound inflicted with the point of a knife, on an adult; a. the cardiac; b, the capillary extremity of the artery; c, the opening of communication between the artery and vein; d d, the collateral arteries dilated, through which the blood found a passage into the vein; e, the dilatation of the vein forming the external tumour; f, the cardiac; g, the capillary end of the vein; h, the valves of the vein, which limited the extension of the tumour downwards. The parietes of the vein were extremely strong, apparently fibrous, and four or five times their natural thickness. All the veins in the upper part of the limb were greatly, but uniformly dilated. The arrow-points indicate the direction of the current of the blood.*

Larrey of Toulouse saw a case of varicose aneurism, which had been occasioned by a sabre wound of the popliteal vein and artery. The tumour, after a few years, had attained the size of two fists, and it was deemed necessary to perform amputation, which was successful. The sac was formed by the distended vein, at the bottom of which the opening of communication with the artery was observed. The nephew of this surgeon, Baron Larrey, in his *Mémoires de Chirurgie Militaire*, relates a case of varicose aneurism of large size, caused by a sabre stab: part of the attachment of the sterno-mastoid muscle was divided with the anterior scalenus, the subclavian artery and vein were wounded deep under the clavicle, and probably also a portion of the brachial plexus.

Dupuytren observed a case at the Hôtel-Dieu below the middle of the thigh, which had been caused by a deep stab made with a shoemaker's knife ; and Breschet who describes this case, in his memoir, also speaks of another in which a communication existed between the common carotid and external jugular vein. This is perhaps the same case, that has since been described in the *Journal Complémentaire des Sciences Médicales*, by M. Williaume, Surgeon of the Military Hospital at Metz, and which was caused by a sword stab just above the clavicle. Sanson had a case in which, from a gun-shot wound, a varicose aneurism was produced in the subclavian vein.

It would appear, therefore, that although the puncture with the lancet in bleeding is the most common cause of this form of aneurism, it is by no means the only one. Varicose aneurism has even been known to occur spontaneously. Mr. Syme of Edinburgh has related in the Edin. Med. and Surg. Journal, July, 1831, an account of a case, in which a communication had been formed between the aorta and inferior cava ; so that, as we sometimes see the true aneurism converted into a diffuse aneurism by the sudden bursting of the sac, so also do we find, as in this instance, a varicose aneurism formed without any wound, the communication having been formed by ulceration of the coats of the vein and artery at the point where they were in contact.

But from whatever cause the disease arises, the effect is the same : the limb feels colder, from want of its accustomed supply of arterial blood, a large portion of which being diverted in its course towards the capillaries, flows into the vein, and returns to the heart without proceeding beyond the point of communication between the vein and artery. Breschet thinks that the current of the arterial blood into the vein, may alternate with that of the venous blood into the artery, an opinion which he thinks proved by the feeling of numbness and cold in the limb, the muscular debility and impaired sensibility, and the singular transformation which the artery undergoes, becoming enlarged and tortuous below the point of communication, and its coats soft, and pliable, like those of the veins.

Varicose aneurism never makes its appearance after the infliction of the wound. The compression which is generally employed to arrest the bleeding from the external wound, causes an adhesion of the superficial wound of the vein, but the wounds of the vein and of the artery remain open or are closed only by a temporary coagulum, which, when the compression is removed, and the natural force of the circulation is restored, becomes detached, and the aneurism then makes its appearance.

There is seldom any difficulty in distinguishing the varicose aneurism. A pulsating tumour, of an ovoid shape, makes its appearance after a wound of a vein placed over the transit of an artery ; the pulsations are synchronous with those of the pulse, and there is likewise a tremulous motion and hissing sound in the swelling. William Hunter, who was the first to ascertain the real nature of this affection, in 1757, describes this noise to be such as would be produced by "a blast of air passing through a small hole." The varicose aneurism is not a disease of a dangerous character, and usually causes but little inconvenience ; in most cases, particularly where the disease has occurred in the neck or superior extremities, the tumefaction of the vein is not very considerable, and remains stationary when the vein becomes distended as far as its coats will permit. The return of the venous blood from the capillary side of the tumour gradually becomes more easy, and in this state the patient may experience little inconvenience during the remainder of his life. Dr. Hunter had seen a case in which no change had occurred for thirty-five years.

Fig. 75.

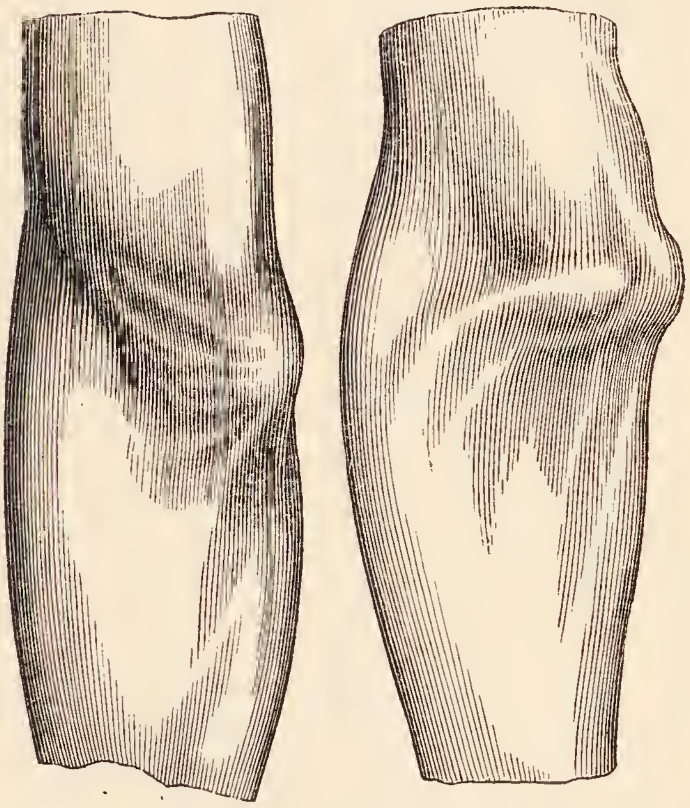


Fig. 75 *represents two drawings of varicose aneurisms at the bend of the arm, taken from casts in the Museum at Guy's Hospital.*

In general, the tumour remains stationary, disappearing entirely when pressure is made on it, and re-appearing as soon as it is taken off. If pressure be made on the artery above the communication, the pulsations or tremblings in the tumour cease, and it begins to diminish in size ; it also diminishes when the arm is raised, and augments when the arm is held down.

There have been cases, however, where a varicose aneurism has continued to increase in volume, and where the subcutaneous veins have become so distended, and the limb so swelled, that it has been thought expedient to tie the trunk of the brachial artery.

Treatment:—In general, gentle support of the tumour, will suffice to keep it in a stationary condition. In some cases, however, it has happened, that the distension of the veins has augmented to such a degree as to determine a necessity for operation. The application of the Hunterian operation in these instances has not been encouraging. Dorsey of Philadelphia, mentions a patient who had been wounded in the leg with buck-shot. After the wound had healed, a varicose aneurism was observed, which continued to make progress. Twelve years after the accident, the veins were greatly distended from the toes to the groin ; there was pain in this region, and some ulcers situated on the foot and ancle could not be healed. The enormous distension of the vessels of the leg, and the uncertainty of finding out the communication between the artery and vein, induced Drs. Physick and Wistar to tie the femoral artery. Gangrene soon ensued, and the patient died of hæmorrhage from a distended vein, which recurred even after the vein had been tied. The whole trunk of the femoral artery was found preternaturally dilated ; all the veins were greatly distended, and a bougie could readily be passed from the popliteal, into the posterior tibial artery, which participated in the dilatation ; and from the latter artery the instrument could be passed into the vein, through a cyst, situated on the inside of the leg, just below the knee.

In a case, in which Mr. Atkinson of York thought it necessary, on account of the large and increasing size of the veins, to take up the brachial artery, mortification of the limb ensued.

" A young man had an aneurismal varix at the upper and inner part of the arm from a wound of the brachial artery and vein. The hæmorrhage, which was great, was arrested by compression ; but, singular to relate, the hand and fingers were drawn into fixed and involuntary flexion. In the course of six weeks, the stiffness of the wrist and fingers wore off, but the patient perceived pulsations in the situation of the cicatrix, synchronous with those of the pulse, and accompanied with the peculiar hissing noise. About two years after, a soft fluctuating tumour of the size of a small hen-egg, formed in the same situation, the pulsations became more distinct, and the hissing noise could be heard in the neighbouring veins, which became greatly dilated. Upon raising the hand, the symptoms were less apparent, and disappeared when compression was made on the artery above the tumour : they persisted, without being either increased or diminished, when compression was made below the tumour. Although the patient experienced no particular inconvenience, he was anxious about it, and consulted Dupuytren, who seeing that it was a case of false aneurism, complicated with varicose aneurism, placed a ligature above the tumour only, acting on the supposition, that as compression below the tumour produced no change in the state of the disease, it would be useless to place one in that situation. The pulsations of the aneurism ceased at once ; but notwithstanding that every precaution was taken in isolating the artery, to avoid including any nerve in the ligature, the fingers became cold and insensible, and the forced flexion of the hand and wrist returned. A slight hæmorrhage occurred on the fourth day, and the ligature came away on the 13th, the wound healing soon after. The hand and fingers, however, remained flexed ; and some time after, notwithstanding that compression had been kept up, the pulsations and hissing noise returned, the tumour enlarging, and the veins becoming more dilated. The collateral arteries had acquired very considerable size, and when compression was made on the artery at a short distance below the point where the ligature had been applied, all the symptoms of the disease disappeared. This circumstance showed the propriety of applying a second ligature, a course which, unfortunately, was not adopted, and the arm was amputated."[1]

In the case from which the sketch, Fig. 74, was taken, a single ligature had been placed on the artery above the opening by which it communicated with the vein. The limb, however, wasted, the nails became detached, and it was ultimately found necessary to amputate the arm. In two cases operated on by Breschet, according to the Hunterian method, the disease returned ; in both these cases, a second ligature was placed below the point of communication, and the patients recovered without any bad symptom.

To these, other cases might be added, in which the application of a single ligature had failed ; the tumour re-appearing soon after, or the limb perishing from gangrene.

The analogy of the varicose aneurism with the false aneurism, is by no means so close as to justify the inference, that because a single ligature will be often found sufficient in the latter, it should be equally so in the former. In the false aneurism, and especially when a sac has been formed in the sheath of the artery or the surrounding cellular tissue, either the opening becomes plugged up with a coagulum long before the collateral vessels have opened a free course for the return of the blood into the lower part of the vessel, or when it arrives there, its current is too feeble to break up the barrier opposed to it, by the coagulated contents of the sac. In the varicose aneurism on the other hand, the communication between the artery and vein is still kept up, by the small quantities of blood that continue to pass from the vein to the artery, until such time as the augmented collaterals restore the current from the artery to the vein, in the same force as before the ligature had been applied. The return of the pulsations in the tumour, is therefore a circumstance which might be anticipated in cases of this kind, where only one ligature had been placed on the artery above the communication. But how is the supervention of gangrene to be accounted for in these instances ? Perhaps it may be a consequence of the mixture of the venous with the arterial blood, this blood subsequently circulating to the extremity of the limb. In one of the cases, in which Breschet successfully placed a ligature below the point of communication, he affirms, that on exposing the corresponding orifices of the artery and vein, he actually saw the mixture taking place.

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[1] Sabatier, Méd. Operat. nouvelle edit. t. iii. p. 189.

The operative process therefore which ought to be adopted, whenever operation becomes unavoidable, is the same as that which would be resorted to in false aneurism of an artery with free and numerous anastomoses, and that is, to place two ligatures, one above, and the other, below the communication. The operation will, it is true, be tedious and difficult, on account of the altered condition of the cellular tissue, and the changed appearance which the parts will have assumed, but it is the only one on which the surgeon can rely with any degree of certainty. In placing the ligatures, the lower one should be the first tied; if the surgeon were to proceed otherwise, he would throw away the assistance which the pulsations would afford him in discovering the lower part of the artery.

The various other modes, that have been proposed to effect the obliteration of arteries, will be noticed under their respective heads, Arteries, Hæmostatics, Torsion, &c.

PARTICULAR ANEURISMS.—SUPERIOR EXTREMITY.

In operating for aneurism, the surgeon ought to secure the attendance of assistants in sufficient number; and to these should be confided the care of laying in proper order, tourniquets, pads for compressing the arteries, straight and curved-edged bistouries, forceps, blunt-pointed scissors, blunt retractors, flexible directors, aneurism needles, ligatures, sponges, cold and tepid water, and whatever else may be deemed necessary.

Aneurismal tumours in the hand, notwithstanding the size of the trunk of the palmar arch, are extremely rare, and occur mostly from wounds, in which case the tumour is formed from extravasation. When the disease has arisen spontaneously, it may be treated successfully, either by compression, or by the ligature of the radial or ulnar arteries, or of both arteries successively, if the first ligature has not had the desired effect. Guattani saw a case of this kind, in which the tumour was as large as an orange, and situated at the base of the hypothenar eminence. When blood is effused amidst the surrounding parts, in consequence of a wound of the artery, it may be possible through the wound to reach the mouth of the bleeding vessel, and secure it. When this cannot be accomplished, and compression does not succeed, the ulnar artery may be tied, at the lower part of the fore-arm, or the root of the superficial palmar arch itself may be laid bare, by making an incision of the length of an inch and a half, extending from the radial side of the pisiform bone, towards the interosseous space between the annular and little fingers. In this situation the artery runs between two veins, the ulnar nerve lying to its ulnar side. The subcutaneous cellular tissue of this part of the palm contains a good deal of granular fat, which juts out of its cells as soon as the incision is made: this must be held aside or removed, in order to bring the vessel into view. A needle armed with a ligature is then passed under the artery from the ulnar to the radial side (see No. 4, fig. 77). This operation is neither so simple, nor so easily performed, as that of tying the vessel at the lower part of the fore-arm; and, as incisions in the palm of the hand ought to be avoided as much as possible, the latter operation, under all ordinary circumstances, ought to be preferred.

The radial artery is also accessible on the back of the hand, where it is about to form the deep-seated palmar arch. The objection to the incision on the hand does not apply to this region. The operation, owing to the superficial situation of the vessel is not difficult, and is performed as follows: The fingers being held straight, and the thumb thrown strongly into extension, the two tendons of the abductor magnus, and extensor longus are rendered prominent. In the depression between them, the artery will be felt pulsating, in the cleft between the posterior extremities of the two first metacarpal bones, close upon their capsular ligaments. After the division of the skin, the cephalic vein, and a branch of the radial nerve are exposed; beneath there is an aponeurosis which conceals the artery; this should be divided on a director. The vessel is then isolated, and the ligature being placed beneath, is tied.

Fig. 76.

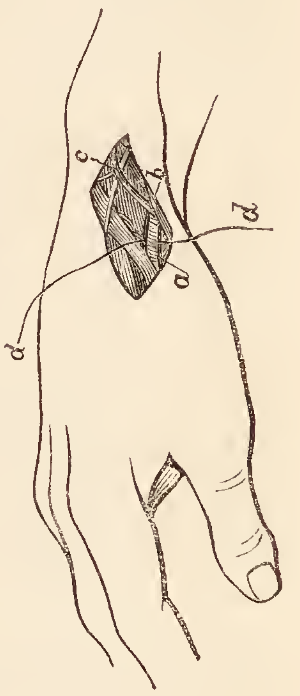

Fig. 76. *a, the artery; b, the radial nerve; c, the cephalic vein; d d, the ligature passed under the artery.*

Both the radial and ulnar arteries however, are more frequently tied above the wrist for aneurismal tumours, or traumatic extravasations in the palm of the hand. In some instances, where the hæmorrhage has returned after the ligation of one of these vessels, the other has been also secured. Some very eminent authorities state, that this proceeding may in general be dispensed with, as the compression of the second vessel, conjointly with the ligation of the first, will effect a cure.

ARTERIES OF THE FORE-ARM.

The fore-arm is supplied by three arteries, the radial and ulnar, derived from the bifurcation of the brachial at the bend of the arm, and the interosseous, derived from the ulnar.

Radial artery, above the wrist.—The fore-arm being presented in supination, and the pulsations of the artery being felt, a longitudinal incision, from an inch and a half to two inches in length, is made in the direction of the vessel. This incision, which divides only the skin and cellular tissue, and runs between the tendons of the supinator radii longus, and palmaris longus, terminates within half an inch of the wrist-joint. This exposes an aponeurosis, which being carefully divided on a director, the artery presents itself to view, between two veins; the radial nerve lies at some distance to its outside. In isolating the artery, it should not be detached from its connexions to a greater extent than is necessary for passing the ligature beneath it. It may be raised indifferently from without, inwards, or from within outwards. (See No. 2, fig. 77.)

Fig. 77.

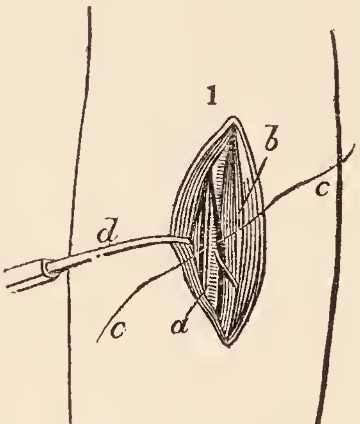

Fig. 77. No. 1, *a, the ulnar artery, the black lines indicating the veins at each side of it; b, the ulnar nerve; c c, the ligature passed under the artery; d, a blunt hook.*

No. 2, *a, the radial artery, the black lines on each side of it representing the veins; b, the radial nerve; c c, the ligature, lying across the wound.*

No. 3, *a, the ulnar artery, the black lines on each side of it representing the veins; b, the ulnar nerve; c c, the ligature lying aslant the wound; d, a retracting hook.*

No. 4. *a, the ulnar artery, its accompanying veins represented by the dark lines at each side of it; b, the ulnar nerve; c d, the ligature passed under the vessel; e, a blunt hook retracting the radial edge of the incision.*

Ulnar artery, above the wrist.—In this region, the ulnar artery lies on the flexor profundus, covered by its own aponeurosis, the tendon of the flexor carpi ulnaris, the subcutaneous cellular tissue and skin. An incision of the same length, and parallel to that for the operation just described, lays open the skin and adipose tissue; the tendon is drawn away towards the ulnar edge of the fore-arm, and the aponeurotic sheath covering the artery carefully divided, on a director. The artery is thus brought into view, lying between its two accompanying veins, the ulnar nerve being a little behind, and to its ulnar side. (See No. 3, fig. 77.) The ligature is passed beneath the artery from the ulnar to the radial side.

Ulnar artery at the upper third of the fore-arm.—The ulnar artery crosses from the point of bifurcation of the brachial, covered by the fleshy mass formed by the muscles arising from the inner condyle of the humerus. At the junction of the upper and middle thirds of the fore-arm, where it first becomes accessible for the ligature, it reposes on the flexor profundus, covered by the sublimis, and flexor carpi ulnaris. In this course, it corresponds with a line drawn obliquely from the middle of the bend of the arm, to the junction of the upper and middle thirds of the fore-arm; from this point, it proceeds in nearly a straight line, down to the radial side of the pisiform bone.

Its anomalies, however, are not unfrequent, and it will now and then be found running more superficially, or nearer to the radial. A vertical incision from two to three inches long, commencing about three fingers' breadth below the bend of the arm, is made in the cellular line that separates the flexor sublimis from the flexor carpi radialis. This line, being divided, the muscles superficial and deep-seated, are separated with the fingers, or the handle of the bistouri. The artery, with its two accompanying veins, is thus exposed; the nerve is on its ulnar side, and more superficial. (See No. 1, fig. 77.) The needle should be introduced from the ulnar side, between the nerve and artery. At this step of the operation, the fore-arm should be slightly bent.

Radial artery at the upper third of the fore-arm.—As we ascend the fore-arm, both the radial and ulnar arteries become deeper seated, and this arises, in consequence of the muscles which terminate in tendons below, being thick and fleshy above. A line drawn from the middle of the bend of the arm to the inside of the styloid process of the radius, will give a tolerably correct idea of the course of the radial artery. In the upper third of the fore-arm, it lies on the flexor profundus, covered by the flexor sublimis, and flexor carpi radialis. The incision should be at least two inches long, beginning about three fingers' breadth below the joint, and should be carried obliquely in the line of the artery and along the ulnar edge of the supinator radii longus. If the superficial radial vein run in the line of the incision, it should be carried to the radial side of the wound. On dividing the skin, the aponeurotic line that unites the flexor sublimis and flexor carpi radialis, is exposed to view. These muscles are separated, and the long supinator being raised, the aponeurosis covering the artery is seen. This being divided on the director, the artery with its satellite veins is seen, having the radial nerve a little to its radial side. (See No. 4, fig. 78.) The needle is passed under the vessel from the ulnar to the radial side; if the hand and fore-arm be bent, this step will be facilitated.

In operating for traumatic aneurisms in the fore-arm, the ligature should be placed as near the wound of the vessel, as circumstances will allow; as otherwise, from the number of branches given off from the main arteries, the blood might find easy access to the aperture of the wounded vessel.

BRACHIAL ARTERY.

The brachial artery may be tied at the bend of the arm, or in its middle or upper part. The course of the vessel corresponds with a line drawn from the middle of the bend of the arm upwards along the inner edge of the biceps, which covers it a little, until it nearly reaches the axilla. At the articulation itself, its course is marked pretty accurately by the median basilic vein, which is visible beneath the skin. Anomalies occur frequently in the distribution of this vessel; the most common is that in which its bifurcation occurs, at various points of its course, from the bend of the arm up to the axilla. As its superficial situation, however, allows of its pulsations being felt throughout its entire course, the surgeon can easily ascertain beforehand, whether such is the case or not. (See fig. 78.)

Fig. 78.

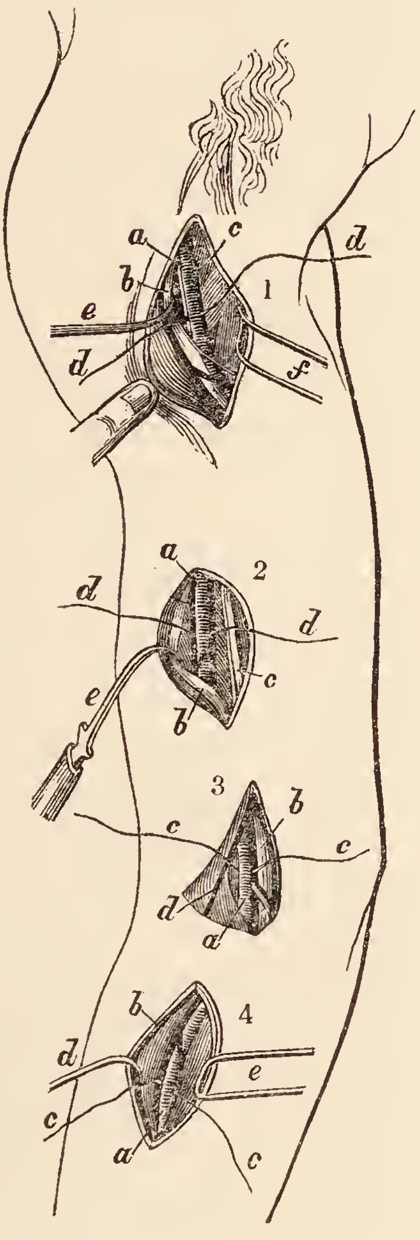

Fig. 78. No. 1. *a, the axillary artery; b, the median nerve; c, the axillary vein; d d, the ligature passed under the artery; e and f, a blunt hook, and retractor.*
No. 2. *a, the brachial artery, the dark lines at each side of it indicating its accompanying veins; b, the median nerve; c, the internal cutaneous nerve; d d, the ligature passed under the artery; e, blunt hook retracting the radial border of the wound.*
No. 3. *a, the brachial artery, the dark lines indicating the satellite veins; b, the median nerve; c c, the ligature passed under the artery; d, the median basilic vein.*
No. 4. *a, the radial artery, the dark lines indicating its satellite veins; b, the superficial vein running along the entire length of the radial border of the incision; c c, the ligature passed under the artery; d and e, a hook, and retractor.*

At the bend of the arm.—In operating, the fore-arm being extended in supination, and the surgeon standing between it and the patient's body, he makes an incision from two to three inches long, in the direction of the artery, beginning above and terminating in the middle of the bend of the arm. The median basilic vein is left untouched on the radial border of the wound. Its lips are kept asunder by an assistant, and the brachial aponeurosis, which is continuous with the tendon of the biceps, is divided on a director. The artery is now seen accompanied by its two veins, one on each side, and having, on its ulnar side, but at some little distance, the median nerve. (See No. 3, fig. 78.) The fore-arm is now bent a little, in order to facilitate the isolation of the vessel, and the ligature is passed beneath it from the ulnar to the radial side.

Aneurismal tumours in this situation are by no means uncommon, but they are chiefly of the traumatic kind, produced by the sword, or by the lancet in bleeding. Their treatment by compression is not unfrequently successful. When an operation is required, great care should be taken to distinguish the artery from the nerve; a task which it will be sometimes difficult to accomplish, on account of all the parts being deeply tinged by the extravasated blood. In these cases the surest plan, when practicable, will be to place a ligature both above and below the wound of the artery.

At the middle of the arm.—The indications of the course of the vessel in this situation, are the inner border of the biceps, a line drawn obliquely from the middle of the bend of the arm, to that of the hollow of the axilla, or its own pulsations. The median nerve, which accompanies the artery throughout its entire course, here crosses obliquely in front of it, and is thus at its radial side above, and at its ulnar side below. (See No. 2, fig. 78.)

The arm is held in the same position as in the preceding operation, and an incision of two, or two and a half inches in length is made, in the direction already described, beginning below, if it be the left arm, and above, if it be the right. The finger of the left hand is now introduced into the wound to feel for the median nerve, which presents itself as a thick, white cord, and the artery which pulsates behind it. The median nerve and biceps being retracted with a blunt hook, the firm aponeurosis enveloping the artery, and the two veins, with which it is usually accompanied is exposed. This should be divided on a director; the artery is then seen, with its veins covering, or at each side of it, and the internal cutaneous nerve on its ulnar side; the ulnar nerve itself lies about half an inch farther back. The cellular envelope of the artery is then opened with the nail or blunt-pointed instrument, and being fairly isolated, a needle is passed beneath it from the radial to the ulnar side. The only difficulty that can arise in the execution of this operation, will depend on an anomalous distribution of the vessel: when the pulsations of the artery cannot be felt, the median nerve will serve as a guide to it, as it will be found just behind it,

At the upper part of the arm.—The artery, in this part of its course, is situated to the inside of the edge of the coraco-brachialis, and a little lower down it begins to be covered with the biceps. (No. 1, fig. 78.) The operation is performed as in the preceding instance.

Compression is also successful in curing aneurisms of the brachial artery, for which the humerus offers a ready point of opposition; and when it does not cure, it retards their progress, or renders them stationary. Winter cured the queen of Bavaria of an aneurism of the brachial artery, by compression, and Lisfranc relates the case of a person who has had four aneurismal tumours in the course of this vessel, the progress of which has been staid for more than a year, by means of a laced sleeve.

In placing ligatures on the arteries of the fore-arm, and arm, the supply of blood to the parts from which any of the main branches is cut off, is sufficiently assured by the great number of minor branches that pass off from them in their course. Thus, when the brachial artery is tied at the bend of the arm, the circulation is carried on between it and the arteries of the fore-arm, by the anastomosing circles, that are distributed above and below the condyles. As regards the nourishment of the inferior part of the limb, therefore, no apprehension need be entertained; but, on the contrary, this communication may be so free, as still to allow the blood to arrive in the wounded vessel, or aneurismal tumour, and thus render it necessary to place another ligature, or to have recourse to compression.

When the brachial artery is tied higher up, the circulation is carried on in the same manner, by the circumflex, the profundus superior, the muscular branches, and by the great anastomotic, when it has been spared; and it is in order to save this collateral circulation, to as great an extent as the disease will allow, as well as to prevent the tumour from being supplied with blood through these channels, that it is recommended, in operating for these aneurisms, to apply the ligature as near the tumour as circumstances will admit of.

AXILLARY ARTERY.

As the frequency of aneurism is relative to the size of the arterial trunk, or its exposed situation, its occurrence in the axilla idiopathically, or from wounds, is not unfrequent. The axillary artery runs in an oblique course, from the lower edge of the clavicle, or from that of the first rib, to the point where it emerges from the hollow of the axilla. At its commencement it lies deep under the clavicle, covered by thick muscles; at its termination, its pulsations can be easily felt within the border of the axilla, where it is covered by the skin, the axillary vein, the median nerve, and its two roots, which mask, or rather envelope it. Throughout this course, it is accessible to the ligature, at three different points. In the first, or uppermost of these, which extends from the clavicle to the edge of the pectoralis minor, the artery is bounded, on its inside, by the walls of the thorax, and serratus major, on its outside by the coracoid process. A triangular space is thus formed which is filled with the strong cellular tissue that envelopes the vessels and nerves, and covered by the pectoralis major, and deltoid. The relative situation of the vessels and nerves in this space is as follows: the axillary vein, a vessel of considerable size, and the first root of the median nerve, partly conceal the artery, the vein lying to the thoracic, the nerve to its scapular side; the artery lies between, and, at the same time, behind them. Before passing under the pectoralis minor, the artery gives off its acromial and external thoracic branches, and the axillary vein receives the cephalic vein with several other branches which pass in front of the artery, and with these also, several small nerves from the great plexus are mingled. The artery emerging from beneath the pectoralis minor, and continuing its course outwards, enters another space, which is bounded by the lower border of the pectoralis minor, posteriorly by the subscapularis muscle, and inferiorly by the border of the axilla; in this course the vein gradually gets from the front to the inside of the artery, and the nerves which had surrounded it almost completely, begin to separate from it; the two roots of the median, which had been in front of it, pass, one to its radial, the other to its ulnar side; the external cutaneous nerve lying on its radial side, the radial and circumflex receding from it behind; branches of veins here empty themselves into the great venous trunk, and the whole is enveloped in the cellulo-fibrous tissue already alluded to, while numerous glands and fat fill up the space towards the thorax. On passing from the edge of the subscapularis, the artery runs parallel to the edge of the coraco-brachialis, till it assumes the name of brachial.

Fig. 79.

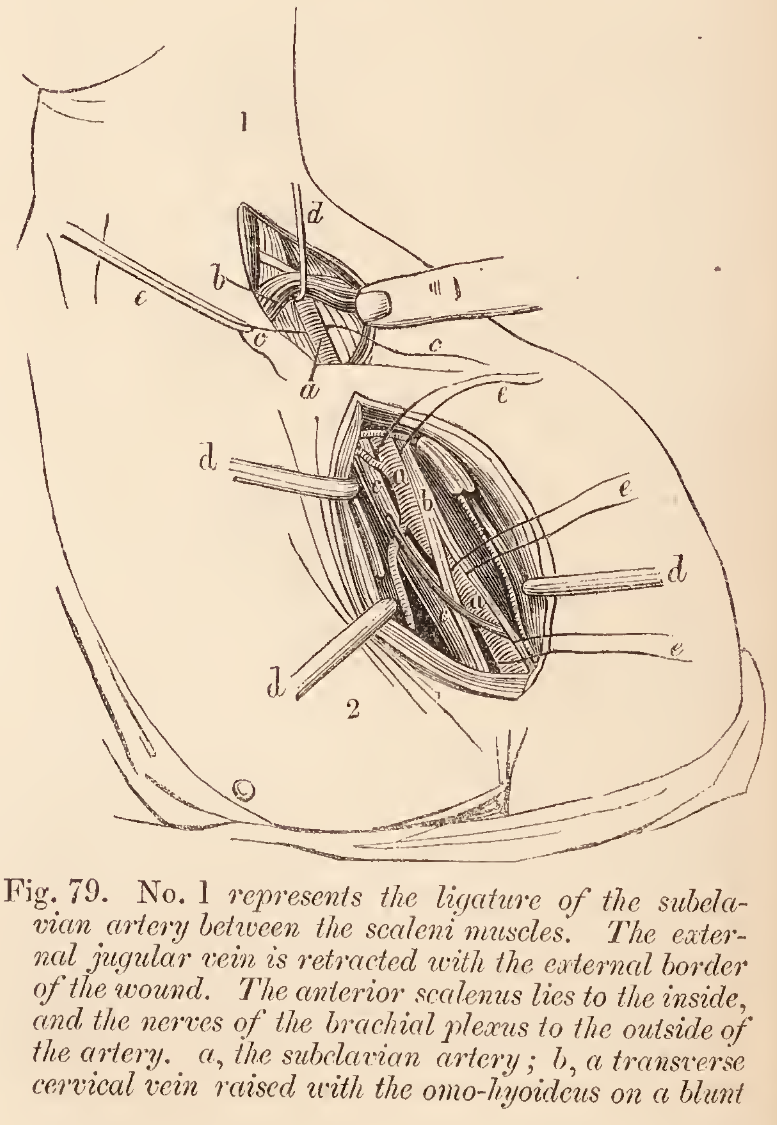

Fig. 79. No. 1 *represents the ligature of the subclavian artery between the scaleni muscles. The external jugular vein is retracted with the external border of the wound. The anterior scalenus lies to the inside, and the nerves of the brachial plexus to the outside of the artery.* a, *the subclavian artery;* b, *a transverse cervical vein raised with the omo-hyoideus on a blunt*

hook, d ; c c c, the ligature passed beneath the artery, and still held in the eye of the needle.

No. 2. *Shows at one view, the three several points upon which a ligature may be placed on the axillary artery ; viz., just below the clavicle, below the pectoralis minor, and within the border of the axilla. The external border of the wound is formed by the deltoid, which is retracted. The internal, by the axillary margin of the pectoralis major. The pectoralis minor is divided, and its remnants are seen in both the borders of the wound at its upper part. a a, the axillary artery, giving off the acromio-thoracic and long thoracic arteries ; b, the median and musculo-cutaneous nerves ; c c, the axillary vein, receiving the cephalic vein, which dips down to it, crossing the axillary artery, with the deltoid branch of the acromio-thoracic artery at the upper angle of the wound ; d d d, retractors ; e e e, the three ligatures placed at different points of the artery.*

Ligature of the artery in the axilla.—The patient being placed in the recumbent posture, and the arm raised, the pulsations of the artery are felt ; the skin is then divided along its course, to the extent of two inches or two and a half ; the incision commencing above, and running longitudinally, at about half an inch within the anterior border of the axilla. In this manner, the knife falls on the edge of the coraco-brachialis, and this is a point of some importance, as leading to the median nerve ; this being found, the artery lies to its inside, and beneath it. If any of the other nerves should happen to be mistaken for the median, the indication, of course, will be fallacious. For the details of this operation, see No. 1, fig. 78, and the lowest of the three ligatures marked *e*, fig. 79.

The incision of the skin exposes the fascia and cellular tissue, which must be carefully divided on a director. The arm is then lowered a little, the median nerve is held to the radial side by means of a blunt hook, and a needle is passed under the artery, which is cautiously isolated from the internal cutaneous, radial, and ulnar nerves, and the axillary vein. From the moment the plexus comes into view, the knife should be laid aside, and the operation completed by means of a blunt blade of silver, or ivory.

This operation may be resorted to in cases of aneurism of the upper part of the brachial artery, or in cases of wounds of the lower part of the axillary vessel itself. John Bell mentions a case in which the axillary artery was divided with a scythe ; the hæmorrhage ceased from syncope, and Hall seized the upper division of the vessel through the wound, and tied it. Maunoir of Geneva treated another case of a sabre wound of the artery by enlarging the wound from the axilla, and placing a ligature, both on the upper and lower divisions of the vessel.

While the question of the value of Brasdor's method remained undecided, it might have been expected that its application to aneurisms of the axillary artery, which gives off such a number of minor branches in its course, would meet but little encouragement. Velpeau, however, hints, that if there was sufficient space between the aneurismal tumour and the giving off of the circumflex and scapular branches, that there might be a reasonable chance of success, and the ideas expounded by Mr. Wardrop, in the general article on this subject in the present work, are calculated to gain favour for such a proceeding, more especially when the aneurismal tumour is not of considerable size. It should be recollected, that the chief ground of fear in treating axillary aneurisms, by ligature above the tumour, either below or above the clavicle, consists in the extension upwards of the diseased condition of the parietes ; and that if the application of a ligature on the capillary side of the tumour failed, the resource of taking up the vessel between the tumour and the heart would still remain.

Ligature of the artery, below the pectoralis minor.—The course of the artery in this situation, corresponds with the cellular line which separates the pectoralis major from the deltoid ; the cephalic vein runs in this line, and will serve as a guide for the incision. The patient is placed on a bed, the head and chest raised, and the arm carried away from the trunk. An incision is then made in the muscular interstice already mentioned, from above downwards for two and a half or three inches, extending obliquely from below the clavicle, to the border of the axilla. The cephalic vein uninjured is included in the pectoral edge of the incision, and the two muscles being separated, are held apart by the assistants. The pectoralis minor is thus exposed, together with the cellular tissue which envelopes the veins, arteries, and nerves. If the finger be now passed beneath the cord which they form together, they may be drawn more fully into view. The vein distended with blood, will be discovered in front, and to the thoracic side of the artery, the artery itself is seen entering between the two roots of the median nerve, and the rest of the plexus, which lies on its scapular side. Delpech, in his case, raised the whole mass in this manner on his finger ; but this step is not necessary, as the artery can be detected, and isolated with a blunt-pointed instrument, without disturbing the parts. A curved needle is then introduced beneath the vessel, from within outwards. Before the ligature is tied, due care should be taken that no nerve is included. If any of the small thoracic arteries should impede the operator, he may tie and divide them. The tendon of the pectoralis minor itself, may, for the same reason, be cut across ; but as this must necessarily weaken the shoulder, it ought not to be done, without positive necessity. For the details of this operation, see No. 2, fig. 79, the middle ligature marked *e*.

As no one would seriously propose at the present day to operate for an aneurism in this situation, with a view to opening the sac itself, the ground on which the propriety of applying a ligature upon the middle division of the axillary artery rests, is that it spares branches that are of importance for the nutrition of the arm. It is unnecessary to allude to the bad effects which must ensue from including a nerve in the ligature; in some of the early cases of ligature of this vessel, the failure of the operation by sphacelus, might doubtless be attributable to this cause. In Desault's case, the brachial plexus was included in the ligature, and the whole arm mortified; and in White's case, where the plexus was also tied with the artery, the same result ensued. Keate, the surgeon-general, operated for an aneurism, that had already burst, by first cutting down on the artery in this situation; but, on finding that the artery pulsated below the ligature, he placed another ligature higher up, near the first rib. Chamberlaine, of Kingston, Jamaica, operated in such a manner, as to combine the method above described, with that which is employed in reaching the vessel close under the clavicle, making one incision transversely under the clavicle, the other obliquely along the border of the pectoralis major, and everting the L shaped flap; his patient recovered in less than a month. (See No. 2, fig. 80.)

Fig. 80.

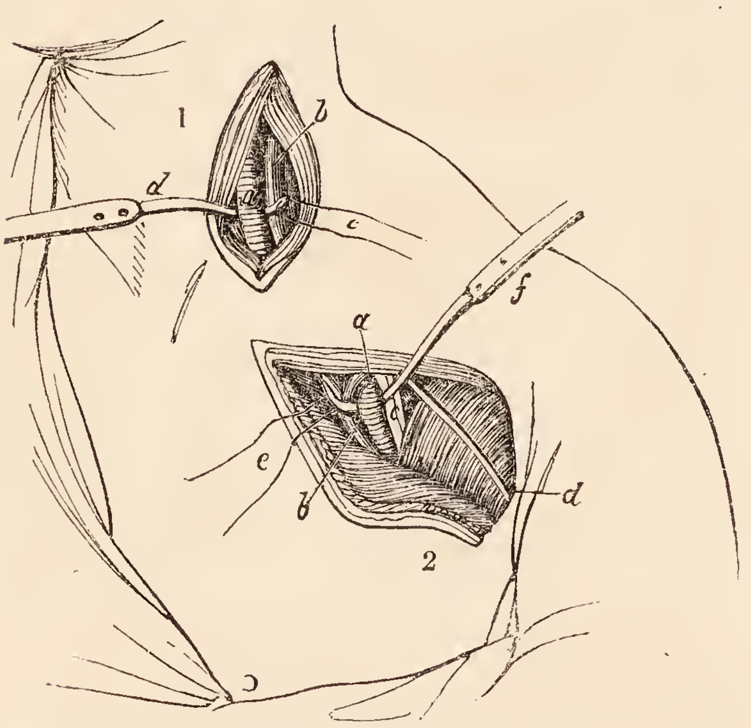

Fig. 80. No. 1. *Sedillot's plan of arriving at the carotid, by cutting down between the sternal and clavicular portions of the sterno-mastoid muscle. a, the carotid artery, the internal jugular vein b, lying to its outside; c, the ligature in the eye of the aneurism needle, d, which is placed under the artery.*
No. 2, *a triangular wound, in the upper border of which is seen the clavicular attachment of the pectoralis major; the flap hangs down, and exposes the pectoralis minor, which is seen crossing the inferior half of the wound, the cephalic vein running upon it. a, the axillary artery, immediately below the clavicle; b, the axillary vein; e, the brachial plexus; d, the cephalic vein going to join the axillary vein; e, the ligature in the eye of the aneurism needle; f, the needle supporting the artery, which is somewhat raised upon it.*

Ligature of the artery just below the clavicle.—In the triangular space already described, the artery is covered by the pectoralis major, and runs in an oblique direction from within, outwards and downwards, till it passes under the pectoralis minor, a little below its tendinous expansion. The patient being placed in the recumbent posture, on a bed or reclining chair, exposed to the light, the shoulder slightly raised, and the arm carried away from the trunk, Hodgson, in order to expose this part of the axillary artery, directs a semi-lunar incision, with its convexity downwards, and about three inches in length, extending from about an inch from the sternal end of the clavicle, and stopping short of the edge of the deltoid muscle, in order to avoid wounding the cephalic vein. This incision divides the skin, and fibres of the platysma myoides. The fibres of the pectoral muscle itself are then divided in the same manner and to the same extent. This dissection should be conducted carefully with a director, until it exposes the whitish layer of cellular tissue. On raising the muscle, the pectoralis minor, which forms the lower boundary of the triangle, is seen crossing the lower part of the wound. The arm should now be brought close to the side, a blunt instrument, or the finger, is employed to depress the edge of this muscle, and clear the vessel from the cellular membrane that connects it with the vein and nerves. On the thoracic side, and somewhat in front, will be found the vein, which swells at every expiration, the nerves of the brachial plexus lying to its scapular side, and somewhat behind it. The safety of the vein must be carefully looked to, and, in isolating the artery, it should be held aside with a blunt hook, and the curved needle should be introduced between it and the artery, or from within, outwards. The ligature should then be raised on the finger, before it is tied, in order to ascertain that the pulsations in the aneurismal tumour are stopped; of course the precaution should also extend to seeing that no nerve be included; and still more so, that a nerve shall not be mistaken for an artery.

Fig. 81.

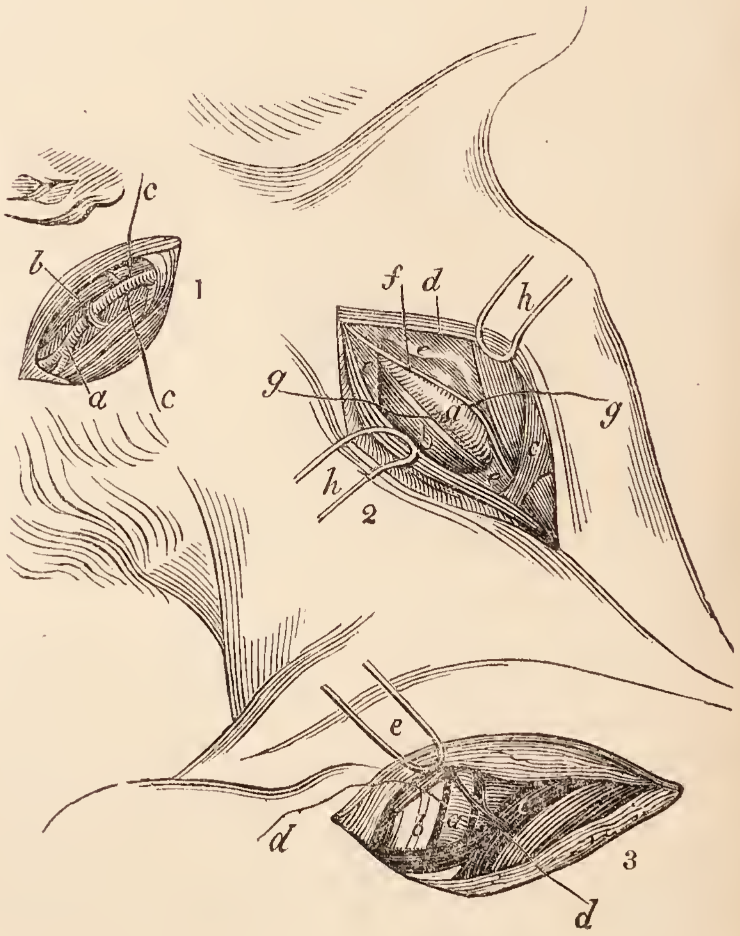

Fig. 81. No. 1. *a, the occipital artery; b, the vein, with its branches crossing the artery; c c, the ligature passed under the vessel.*

No. 2. *a, the carotid artery; b, the internal jugular vein; c, the omo-hyoideus muscle; d, the external jugular vein; e e e, the sheath of the artery and vein, which has been laid open; f, the descendens noni; g g, the ligature passed beneath the artery; h h, retractors holding the lips of the wound asunder.*

No. 3. *Mr. Hodgson's plan. a, the axillary artery; b, the brachial plexus; c, the vein receiving the cephalic vein and other lesser veins; d d, the ligature passed beneath the artery; e, a retractor raising the convex border, or flap of the wound.*

This is the usual mode of cutting down on the superior third of the axillary artery; the objection to which it is liable, on account of the transverse section of so many muscular fibres, has given origin to another method, which is an extension of the preceding one, and seems to deserve a preference; though, of course, this must depend more or less on the nature of the case requiring its application. The pectoralis major consists of a sternal and a clavicular portion, at the junction of which there is an interstice, which can be rendered still more distinct, by forcibly abducting the arm. In this line an incision of the integument is made, and the two portions of the muscle are carefully separated down to the cellular layer in contact with its under surface. The direction of this incision runs in an oblique line, produced from the outer edge of the sterno-cleido-mastoideus, beginning at the inferior border of the clavicle, at the junction of its inner, with its two outer thirds, and extending downwards about three inches. The two portions of the muscle being held asunder, the vessels and nerves are seen in the relative positions already described. The arm is then brought close to the trunk. If the space obtained by separating the two portions of the muscle should not be found sufficient to enable the operator to isolate the artery with facility, he may divide transversely some of the fibres attached to the clavicle, on a director, or with a probe-pointed bistoury. The artery is separated from the vein in the same manner, as before-described, and the ligature being passed beneath it, the operation is terminated. The hazardous dives made with the needle, which were practised in the early operations on this vessel, are now very properly condemned, and universally rejected.

After the ligature has been placed on the main trunk, although the arm does not possess the same advantages in point of supply as the thigh, it not having any vessels to correspond with the internal iliac, and profunda, still the circulation will be carried on, and sufficient nourishment afforded through the superior branches, the acromial, superficial scapular, transversalis colli, and internal mammary, all of which anastomose with the circumflex, subscapular, and internal mammary.

In operating on the axillary artery, the cutting instrument should be laid aside as soon as the cellular tissue which invests it, is exposed; the rest should be effected with the finger-nail, or a blunt-pointed instrument.

Axillary aneurisms, like all others, have been sometimes observed to undergo spontaneous cure; but to refrain from operating at an early stage, when the chances of success are greatest, in the hope of such an unlikely result, would be mere folly. These operations are certainly difficult, and demand the utmost patience and pains'-taking; any attempt at hurry or display in the performance, would be highly culpable.

SUBCLAVIAN ARTERY.

Though the course of this vessel be short, it may be tied at three different points, viz. on the first rib, to the outside of the anterior scalenus; between the two scaleni; and on the inside of these muscles.

Fig. 82.

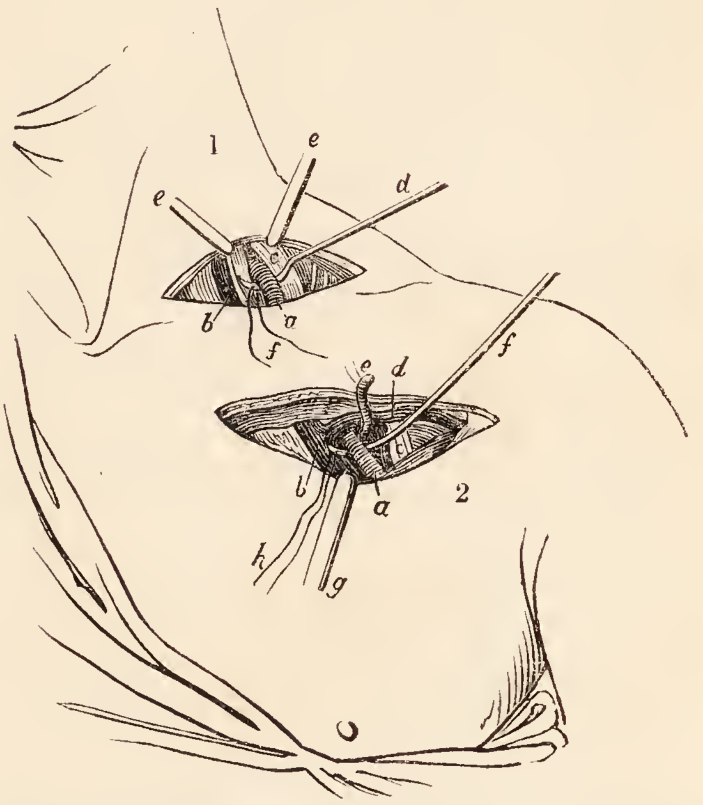

Fig. 82 *represents the operation by transverse incision for placing a ligature on the subclavian artery above, and on the axillary artery below the clavicle. The shoulder is depressed, and the arm drawn away a little from the trunk; the neck is stretched, and the head inclined to the opposite side.*

No. 1. *a, the subclavian artery, raised on an aneurism needle d, and presenting itself between (c) the nerves of the brachial plexus, which lie to its outside, and the edge of the anterior scalenus, which lies to its inside, separating it from b, the external jugular vein, which descends behind the clavicle to empty itself in the subclavian vein; the outer border of the clavicular attachment of the sterno-cleido-mastoid is seen in the inner angle of the wound; the omo-hyoideus is raised with the upper border of the wound, and branches of nerves are seen crossing it at the external angle; e'e, retractors; f, the ligature.*

No. 2. *In the upper border of the wound the clavicular attachment of the pectoralis major is seen divided; in the lower, the superior border of the pectoralis minor and the section of the pectoralis major are depressed. a, the axillary artery raised on an aneurism needle; b, the axillary vein receiving the cephalic vein, which crosses the brachial plexus and the artery. A branch of the thoracico-acromialis which impeded the operation, was tied, and is seen turned back upon the upper lip of the incision; c, the nerves of the brachial plexus; d, the cephalic vein; e, the thoracico-acromialis which has been cut and tied; f, the aneurismal needle sustaining the artery; g, a retractor; h, the ligature hanging from the eye of the needle.*

At the external edge of the anterior scalenus, the subclavian artery lies deep in a triangular space, which is bounded below by the clavicle, internally by the scalenus, and externally by omo-hyoideus muscle. This space is traced superficially by the external edge of the sterno-cleido-mastoid, the anterior edge of the trapezius, and the upper edge of the clavicle. This hollow, which is defined to the eye, contains the following parts in succession from without, inwards: the skin, platysma myoides, subcutaneous adipose tissue with lymphatic ganglions, and veins; the external jugular, advancing on this space more or less, here dips down with other lesser veins to join the subclavian. The artery rests on the first rib and intercostal space, having the vein on its inside, and separated from it by the scalenus muscle, and the cervical nerves descending to form the brachial plexus on its outside and inclining behind it; above it, is seen the omo-hyoideus crossing obliquely.

The operation of cutting down upon this portion of the artery is thus performed:—the patient being placed on a bed, the head and chest raised, and the arm drawn downwards and forwards, an incision running above the clavicle, and parallel to that bone, is made from the outer edge of the sterno-mastoid to the anterior border of the trapezius. This divides the skin only; a second incision divides the cellular membrane and platysma myoides: if the external jugular vein should lie in the line of the incision, it should be carried out of the way of injury with a blunt hook: the deep-seated cervical fascia comes next, which being divided on a director, the cellular tissue that contains the lymphatic ganglions and veins already mentioned rises a little; it contains, also, two arterial branches—the transversalis colli and the transversalis scapulæ, which may require a ligature. The surgeon seeks with his left index finger in the wound for the external edge of the scalenus, which leads him at once to the artery lodged in the angle formed by its attachment to the first rib. The vessel being carefully isolated, the armed needle is passed beneath it from its inside, and the operator, after assuring himself of its effect on the aneurismal tumour, ties it firmly by means of a serre-nœud, if it should be too deep to be properly done by his fingers. This step of the operation will be facilitated by lowering the shoulder, and inclining or turning the patient's head to the opposite side. The depth at which the artery is found varies, being more superficial in the lean and long-necked. When the tumour is very considerable, this depth is still further increased by its uplifting the clavicle; owing to this cause, Sir A. Cooper was unable to put a ligature on the vessel, after he had made the necessary incisions. If the extent of the incision be too limited, owing to the clavicular portion of the mastoid muscle spreading along the bone, it has been recommended to divide its fibres to the extent necessary: others recommend the incision to be made in the form of L reversed. Physick recommends a V shaped incision. If, from the great depth of the artery, the difficulty of placing a ligature upon it should prove considerable, part of the anterior scalenus may be divided; this was done in the case on which Mr. Liston operated: half only of the muscle was divided, in order to avoid all risk of wounding the phrenic nerve.

Ligature of the Subclavian Artery between the Scaleni Muscles.—In this part of the vessel's course it is free from close connexion with any important parts. The incisions are made in the same manner, with this difference only, that, internally, the border of the mastoid muscle is divided. On arriving at the outer border of the anterior scalenus, a curved director, guided on the finger, is carried behind it. This manœuvre requires great caution. The phrenic nerve runs under this muscle, and again to its sternal side are the subclavian and internal jugular vein. The index finger should, therefore, be passed under the muscle, so as to meet the director; its inferior attachment is then divided, the muscle immediately retracts, and the artery is easily discovered. If any arterial branches are distributed in front of the muscle, they should be secured before dividing it; or without waiting for this, the muscle may be cut higher up. After this section, the artery may be very easily isolated.

The majority of these operations have been performed with a transverse or horizontal incision, rendered, in the cases of Mr. T. Blizard and Dr. Post, slightly oblique. In Mr. Porter's case, the deviation from the ordinary method was more considerable, as he added to the horizontal incision a vertical one, in the line of the external border of the mastoid muscle, forming an L flap, which was everted. Hodgson's method for ordinary cases undoubtedly deserves the preference; but the size of the tumour, the corpulency of the patient, or other circumstances may be such as to justify the operator in modifying the method in such a manner as may best suit the nature of the case he has to treat.

Ligature of the Subclavian Artery on the inside of the Scaleni Muscles.—Here the vessel rising out of the cavity of the thorax lies close upon the spine, and covered in front by the sterno-clavicular articulation, and the insertion of the sterno-mastoid muscle. There is some difference in the arteries of the right and left side, both as regards their length and the parts with which they are connected. The left subclavian arises directly from the aorta; its lowest part is covered by the lung, and the subclavian vein, close upon the point where the thoracic duct penetrates it from behind; the carotid, which gradually recedes from it on rising from the arch of the aorta, lies to its inside, where is also the œsophagus, in front; the phrenic, and pneumo-gastric nerves pass into the chest, just before it. On the right side it arises from the innominata, and is, on that account, much shorter: on its posterior surface it gives off the vertebral artery; the recurrent nerve here turns round its base, to reach the trachea; it is crossed in front by the phrenic and pneumo-gastric nerves; it gives off in this short course no less than six important branches, and is covered below by the termination of the internal jugular vein.

Beset with difficulties at every step, and dangers of the most formidable kind, as this operation must be, it has nevertheless been performed. Dr. Colles, of Dublin, having a case of aneurism of the right subclavian artery, in which the tumour extended from behind the sterno-clavicular articulation upwards along the edge of the muscle, and outwards to the middle of the clavicle, was bold enough to cut down upon this part of the subclavian artery: the dissection was of course tedious, and on arriving at the vessel only a very small portion of it was found to be in a healthy state; and on this, after considerable difficulty, the ligature was placed. From symptoms of oppression at the heart and dyspnœa that occurred at the moment, it was feared that the pleura had been injured, and, in consequence, it was deemed prudent not to tighten the ligature till the fourth day after. The patient continued in a tolerably quiet state till the ninth day, when he was attacked with pain at the heart, accompanied by a sense of suffocation: he died delirious, after a few hours' suffering. Both the aorta and subclavian were diseased.

The operation has not since been attempted by any other surgeon. On the dead body it is performed in the following manner: an incision is made over the clavicular portion of the mastoid, extending outwards to within an inch of the trapezius. This portion of the muscle is next divided on a director, or with a blunt-pointed bistoury. The anterior scalenus is then seen, to the tracheal side of which the pulsations of the artery may be felt. The most difficult step of the operation still remains, which is not so much the passing a ligature round the artery, as the isolating it from all the important parts that surround, or are in contact with it, at almost all points.

Whether this operation ought to be attempted under any, or even under favourable circumstances, is a question which now presents a different bearing from that which it had when Dr. Colles performed it. Brasdor's operation at that time had almost fallen into oblivion. But now, that we know that aneurisms of the first magnitude may be cured, not only by cutting off the circulation within them, but also by causing it to become more slow and languid, Brasdor's method presents itself as an alternative in such cases, which, all things considered, may deserve the preference. Dupuytren treated a case in this manner; and although the issue was not successful, as the patient died on the ninth day, still the tumour had diminished considerably, and his death seemed to arise in consequence of hæmorrhage from another vessel than that on which the ligature had been placed.

The most cogent reason for operating at an early stage in cases of axillary aneurism, is this—that tying the subclavian is comparatively an easy task, before the tumour has become large, and forced the clavicle upwards; and the higher we ascend on the vessel, the greater the hazard. The interscalenar portion of the vessel should always be spared, if there still be space left for the ligature between the scalenus and the clavicle; and if the case will admit of a ligature being placed below the clavicle, it is still better. This precept is not founded exclusively on saving the collateral circulation to the utmost extent possible, for in the cases of this operation that have proved fatal, gangrene has been but rarely observed; it is also based on the fact, of the greater frequency of dyspnœa, suffocation, pain at the heart, fever, and delirium, in proportion as the ligature of this vessel has approached nearer to the centre of the circulation. In fact, where the ligature had been placed high on the vessel, it has been remarked with what rapidity the anastomosing branches have conveyed the blood into its old channels: in some, the pulsations have re-appeared in the tumour as early as the second day after the operation.

Ramsden was the first who performed this operation. In the early cases the failures succeeded each other without interruption, until Dr. Post, of New-York, was fortunate in the case that he operated on in 1807. Since that period, the operation of taking up the vessel between the anterior scalenus and clavicle has been successful in the hands of Dupuytren, Bullen, Green, Gibbs of St. Petersburgh, Key, Langenbeck, Liston, Mott, Porter, Wardrop, &c.: the successful now exceeding the unsuccessful cases by a few. With respect, therefore, to results, they are not more encouraging from being placed on the cardiac, than on the capillary side of the aneurism.

INNOMINATA, OR BRACHIO-CEPHALIC ARTERY.

The innominata arises from the arch of the aorta itself, on its right side, and after ascending about two inches towards the articulation of the sternum and clavicle of the same side, gives origin to the right carotid and subclavian. It lies deep, having in front the left subclavian vein, the pneumo-gastric nerve, and some of the branches of the great sympathetic, and behind to the left, the trachea: it is in contact with the pleura to the outside. Though more profoundly situated, it is more accessible than the commencement of the subclavian artery, and can be more easily isolated than that vessel from the investing parts: it is also free from branches.

The innominata was first tied by Mott. He performed the operation as follows:—The patient having been placed on his back, the head thrown considerably backwards, in order to cause the vessel to ascend as much as possible out of the chest, and the face being turned a little towards the left shoulder, an incision three inches in length was made in a horizontal direction, extending from the median line of the neck outwards, and above the clavicle; a second incision of the same length was then made in a line with the internal edge of the mastoid muscle, until both met. The sternal, and part of the clavicular attachments of this muscle were then divided, and the flap turned upwards; the sterno-hyoid and thyroid muscles were then cautiously divided. The artery was then isolated and tied. Græfe adopted the same method in the case on which he operated; and Mr. Porter, of Dublin, operated in a similar manner, in taking up the lower part of the carotid.

Fig. 83.

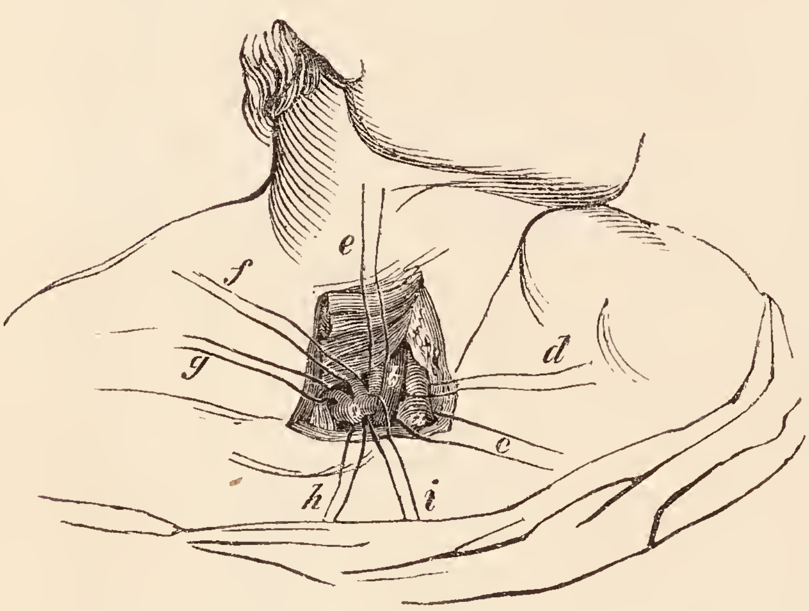

Fig. 83. *Mott's plan of tying the arteria innominata. By a vertical and transverse incision, the inner portion of the sterno-mastoid muscle is detached from the clavicle and raised as a flap. At the inner border of the wound, the arteria innominata (a) presents itself, with the internal jugular vein (b) descending to its outside, and covering the origin of the subclavian artery. To the outside of the vein is seen the subclavian artery (o), giving off (e) the vertebral artery, which is here drawn forward from behind the vessel; f, the inferior thyroid; g, the transverse cervical; and h, the internal mammary. A ligature is placed on each of the arteries: i, e, and d, marking those of the subclavian, innominata and carotid. By this plan it will be seen, that the subclavian artery, from its origin to the scalenus muscle, is equally exposed with the innominata itself. The tendon of the scalenus is seen in the outer angle of the wound.*

A more simple method than the preceding has been devised by Dr. O'Donnell, of Liverpool, and is thus described by Mr. King in his Thesis: "Standing to the left of the patient, close to his head, which is thrown backwards, I make an incision about an inch and a half in length, along the internal border of the left sterno-cleido-mastoid muscle, beginning at the sternum and dividing the skin, cellular tissue, some of the fibres of the platysma myoides, and the middle portion of the cervical fascia. I then separate the borders of the incision, and divide the cellular line which runs between the internal margins of the sterno-thyroid muscles, and introducing my left fore-finger under the right sterno-thyroid, divide with my nail or a probe-pointed bistoury, the strong sheet of the cervical fascia that exists between the muscle and the trachea. The finger passed under this fascia descends on the trachea till it touches the arteria innominata, and carefully recognising the position of the artery and causing the head to be bent forwards, I employ the same finger in carrying forwards the left subclavian, and right internal jugular veins. These veins being thus protected, I pass the aneurism needle, armed with a round ligature, between my finger and the artery. The ligature being now placed round the vessel, is tightened slowly and with due precaution. The operation is by no means difficult, on the dead subject at least; nor does it expose to injury, either the pleura, or the pneumo-gastric nerve. It is, moreover, equally applicable to the subclavian and right carotid arteries, with but very slight modification."

If this mode should be resorted to in placing a ligature on the right subclavian, between the scalenus posticus and the trachea, the finger must be directed more obliquely outwards, care being taken to avoid the pneumo-gastric and phrenic nerves. The best way of doing this will be to press the former inwards, and the latter outwards. The noose, formed round the artery by the recurrent nerve, may be easily felt, and of course must be avoided also. The pleura, if it should impede the operator, may be detached gently downwards.

The same mode is also applicable to the left subclavian; but in this case, the surgeon stands to the right of the patient, and instead of cutting in the line of the muscle on the left, he makes his incision along the internal border of the right sterno-mastoid, raising the left sterno-thyroid, and sterno-hyoid muscles. The left fore-finger then descends along the left of the trachea, on the left carotid, and left side of the spine. The pneumo-gastric and phrenic nerves are set aside as before, and the pleura is detached with extreme precaution. The step is difficult on the dead subject, and must be much more so, and perhaps impossible, as Mr. King observes, in the living patient. The isolation of the artery requires much time and care, and in placing the ligature, it should be as distant as circumstances will allow, from the thoracic duct, and great sympathetic nerve. The branches given off from this portion of the vessel on the right side are numerous, but this is not the case with the left subclavian, a circumstance which would weigh much in favour of the chances of a successful result.

The doctrine here propounded by Mr. King had probably excited either curiosity or doubt in the minds of his examiners, more especially as regarded the ligature of the innominata, and he was accordingly requested to demonstrate what he had advanced. A dead body was produced, and in the midst of the hall of the faculty, Mr. King at once satisfied his examiners and a numerous audience, that his plan was not only practicable, but that it might be promptly executed.

Fig. 84.

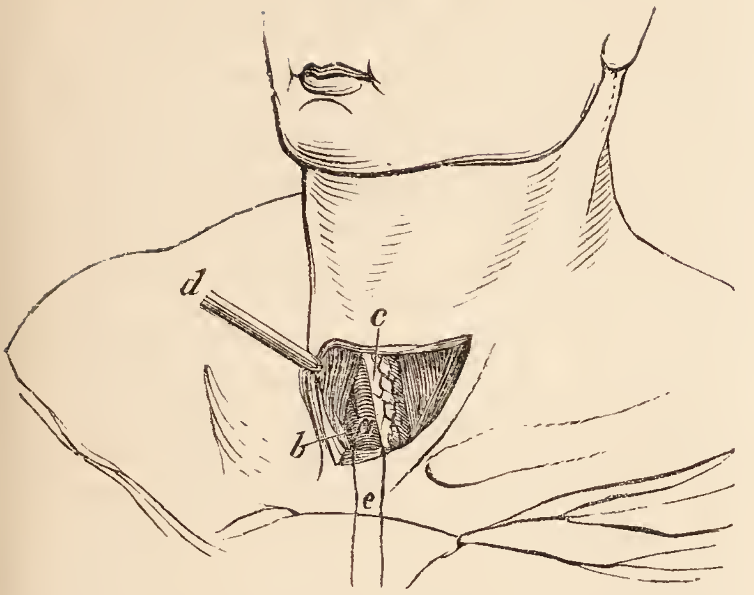

Fig. 84. *Mr. King's plan of tying the arteria innominata, or the first division of the subclavian artery between its origin and the scalenus. The muscles seen at either side of the wound, are the sterno-mastoid, sterno-hyoid, and sterno-thyroid. In the middle the trachea (e) presents itself with the inferior thyroid veins ramifying upon it; to its outside is seen the innominata bifurcating. The vein (b) is also seen in the inferior angle of the wound; between it and the trachea, a ligature (e) is passed round the artery (a); d, the retractor.*

But though this operation may be effected without much difficulty in the dead body, it must be very different in the living. The veins from the laborious breathing must at every expiration be swelled with a fresh wave of blood, and consequently are exposed to injury even from blunt instruments; and besides the difficulties and dangers of every kind must be greatly augmented from the proximity of the tumour itself, and the changes which its progress must have induced in the condition and relation of all the parts interested in the operation. But it is unnecessary to dwell further on its perils or difficulties, as in all probability the principle so ably developed by Mr. Wardrop, and the resource he has created for such unhappy cases, will be preferred in future. If, however, any surgeon were disposed to weigh the relative value of the two methods in regard to a given case, he should bear in mind, that the tumour which appears above the sternum may be only a portion, and that perhaps the smallest, of the disease.

The circulation is maintained in the parts from which the main channel is thus cut off in a very circuitous way. The vessels of the opposite side convey the due supply by the anastomosing branches, so that the blood reaches the subclavian and carotid through the branches by which they communicated with the same vessels. The two cases in which the brachio-cephalic trunk has been tied, prove sufficiently that these sources are equal to the supply of the parts beyond the ligature, as in neither was any symptom of gangrene observed. Dr. Mott's patient was operated on in 1818, and was convalescent till the 23d day; a small point of ulceration at the back of the vessel then gave issue to the blood for the first time, and he died exhausted from successive returns of the hæmorrhage on the 26th day. M. Græfe's patient lived till the 58th day, dying also from a violent hæmorrhage, which he presumed might have been in some degree attributable to his having left, for greater security, a presse-nœud in the wound.

Though the brachio-cephalic trunk has been obliterated spontaneously in several instances, it by no means follows that the same result would be obtained by placing a ligature upon it. The spontaneous obliteration is a slow process, whereas the obliteration by ligature is the operation of a few days or weeks; the ligature cuts through the artery, while the adhesions between the sides of the vessel are still fresh and soft, and under these circumstances their solidity can scarce be relied on, in a situation where they are exposed to the powerful impulses of the centre of the circulation. The two instances of the failure of the operation from hæmorrhage alluded to above, confirm this view of the subject.

CAROTID ARTERIES.

The primitive or common carotids arise on the right from the innominata, on the left from the arch of the aorta; the latter is consequently longer than the former. At the lower part they lie deep, covered by the platysma-myoides, the sterno-mastoid, hyoid, and thyroid muscles, and run upwards before the transverse processes of the cervical vertebræ, between the larynx and trachea, on the inside, and the internal jugular vein which lies outside, and somewhat in front. Between, and behind the vein and artery, is the pneumogastric nerve included in the same strong sheath with them. On the left side the artery lies also close by the œsophagus, which comes out a little on that side from behind the trachea. The course of the carotids upwards towards the angle of the lower jaw appears to be directed in a slight degree obliquely backwards, in consequence of the projection of the os hyoides and larynx. It disengages itself from the muscles as it ascends, and becomes, in the middle of the neck, so superficial that its pulsations can be distinctly seen, being covered only by the skin, platysma myoides, and fascia. The omo-hyoid muscle here crosses it to reach the os hyoides, and divides the side of the neck into two triangular spaces. The artery may be tied in either of these spaces.

Ligature of the Carotid Artery.—The patient is placed on his back, the chest elevated, the neck stretched, and the face turned to the opposite side. The pulsations of the artery having been felt, an incision, three inches in length, is made along the internal border of the mastoid muscle, extending from the level of the cricoid cartilage, nearly down to the sternum. The subcutaneous cellular tissue, the platysma myoides, and the cellular tissue that connects the sterno-mastoid, hyoid, and thyroid, muscles are next divided in succession. If any external veins should lie in the direction of the incision, they must be set aside. The situation of the incision itself will only vary according to the part of the vessel to be tied, and may be higher or lower in its course. The head being now bent, the lips of the wound are opened wide. If the omohyoid muscle be in the way, it may be set aside; or should this be not practicable, it may be divided on a director. The vein and artery are now seen enveloped in a very strong fibrous sheath. They are at once distinguished from each other by their relative positions, as well as by their difference of colour, the one being a dark blue, the other a whitish yellow. As the vein, on account of the thinness of its coats, should be an object of especial care, the perforation of this tough sheath should be effected with a blunt instrument over the artery. This being done, the director is introduced, and the sheath laid open. If the internal jugular, from its being swollen with blood, should mask the artery, it should be compressed by the finger at the upper part of the wound, its fulness will be thus made to disappear. They are then separated, and the pneumo-gastric nerve is carried on the same side as the vein; the needle is then passed from without, inwards, beneath the artery, and in doing this, care must be taken not to include the descendens noni which lies on its tracheal side. (For the details of this operation, see No. 2, Fig. 81.)

If the jugular vein were unfortunately wounded, the surgeon might pursue the same course as the late Mr. Simmons of Manchester, who placed a ligature upon it; or as Mr. Guthrie, who, in the case of another vein, pinched up the lips of the wound on its side, and tied them, thus leaving a portion of it still permeable; or he may plug the whole solution of continuity.

M. Sedillot has proposed another method of cutting on the artery at its lower part, by making an incision between the sternal and clavicular portions of the sterno-mastoid muscle. This incision exposes the vein and artery; the latter is then isolated in the manner already described. This proceeding has not been as yet executed on the living body.

In a case of carotid aneurism, in which the sac had burst into the œsophagus, and where the tumour was situated very low down, Dr. Robertson of Edinburgh operated by guiding the incision along the internal border of the sterno-mastoid muscle. No greater difficulty was encountered in the operation than might have been fairly expected to arise from the too limited extent of the external incision, which was but little more than an inch. The sterno-thyroid, and part of the sterno-hyoid muscles were divided transversely. A small prolongation of the sac was then seen between the carotid and the trachea. There was only space enough between the sac and the innominata to insert the end of the finger, so that the ligature was upon the carotid, within half an inch of its origin from the brachio-cephalic trunk. The tumour had effected such a displacement of the neighbouring parts, that neither the veins, nor nerves were seen. The wound healed by granulation, the ligature being detached on the seventeenth day[1].

From the superficial situation of the carotids it might be supposed that the diagnosis of aneurism in this vessel might be a matter of little difficulty. Some mistakes have, however, occurred, which have been attended with fatal consequences. Scarpa mentions an instance in which a carotid aneurism was opened for an abscess; and in another case mentioned by Harder, a patient died under the surgeon's hands. The surgeon should, therefore, take all proper pains on this point, and pay strict attention to the rules by which two such different affections are to be discriminated.

Long before the idea of placing a ligature on the carotid had been entertained, several cases had been observed in which the vessel was spontaneously obliterated; and one instance is recorded in which both carotids were obliterated. The first instance in which it appears to have been tied, occurs in Hebenstreit's Translation of B. Bell's Surgery: in extirpating a scirrhous tumour, the carotid was wounded: the surgeon, to save the patient's life, immediately tied the vessel, and she lived many years afterwards. Abernethy was the next to perform this operation successfully; and was followed by Fleming, a naval surgeon, who tied the wounded carotid in a sailor who attempted to commit suicide. Since that period the ligature of the carotids has become a common operation, and has been had recourse to in a very great variety of cases. In the extirpation of the lower jaw, or of large tumours in its vicinity, it has sometimes been employed as a preliminary proceeding. It has also been found successful in curing erectile tumours, or aneurisms by anastomosis, developed on various parts of the head and face. Mr. Travers tied the carotid in a case of this kind, in which, from the progress of the tumour, the eye was extruded from its socket; the disease was perfectly cured. Mr. Dalrymple treated a similar case in the same manner, and the termination was equally satisfactory. Arendt treated another case in this manner, and Mr. Wardrop pursued the same course in a case of aneurism by anastomosis of the eyeball in an infant. It has also been employed successfully in arresting hæmorrhage arising from ulcerations of the pharynx and larynx. The operation of tying the primitive carotid is applicable to aneurismal tumours developed superiorly to the point of ligation, and to those which occur in its subdivisions, the facial, temporal, and occipital, when compression is found unavailing; while the absence of branches throughout a great part of its course, renders it peculiarly eligible for the application of Brasdor's method in cases of aneurism of the innominata.

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[1] Dublin Journal of Medical Science, &c., January, 1838.

Wounds of the carotid are not necessarily fatal. Some instances are on record in which the blood having but a small external vent became diffused, thus giving rise to a traumatic aneurism. Cases, too, have occurred in which wounds of the carotid have been successfully treated by compression alone. Acrel, Van-Horne, and Larrey, make mention of three such instances.

The sources of supply are so abundant, after the ligature of the carotid, that there is not the slightest danger to the parts either within or without the cranium, from which the main stream has been diverted; and no one now entertains the slightest fear for the intellectual or other functions of the brain. Indeed, the branches of the opposite and corresponding vessels anastomosing with those of the obliterated trunk, replenish them so very rapidly, that in some instances the pulsations have reappeared in the tumour, after a brief suspension, and thus rendering it necessary to have recourse to compression to make the cure certain. This phenomenon so often observed furnishes indisputable proof of the correctness of Mr. Wardrop's position, that a languid state of the circulation is sufficient to lead to the gradual obliteration of an aneurismal sac.

Irregularities in the distribution of the carotid artery usually arise from some variation of the point at which it bifurcates; the division into the two secondary branches may take place as low down as the sixth cervical vertebra, or as high up as the styloid process; or again, there may be no bifurcation, in which case the primary carotid, after giving off all the branches usually furnished by the external, is continued as the internal carotid.[1]

The irregularities of the secondary branches follow in the same order; but some occur independently of any anomaly of the primary trunk. Thus the superior thyroid may arise from the external carotid, a little above the bifurcation, or it may arise either from the external, or from the common carotid by a common trunk with the lingual artery. Sometimes it is wanting altogether. The lingual and the facial may also arise by a common trunk from the carotid. The latter is peculiarly liable to variation, insomuch that it is seldom distributed in the same manner at each side, in the same person.

INFERIOR THYROID, SUPERIOR THYROID, FACIAL, AND LINGUAL ARTERIES.

The inferior and superior thyroids, the former a branch of the subclavian, the latter a branch of the common carotid, have been tied in cases of degenerescence or hypertrophy of the thyroid gland.

Ligature of the Inferior Thyroid and Vertebral Arteries.—The inferior thyroid arising from the subclavian, or from a root common to it, and the ascending cervical, runs upwards and inwards behind the internal jugular vein and carotid, and the pneumogastric nerve, and just before the vertebral artery, and longus colli muscle, until it gets behind the lobe of the thyroid body; it is crossed and covered by the omo-hyoid muscle. It may be cut down upon in the same manner as the carotid, and sought for under this muscle between the carotid and the trachea, or the œsophagus and trachea, if it be on the left side. Care must be taken not to injure the descendens noni, or the recurrent nerve. Sedillot's plan of tying the carotid by cutting down between the sternal and clavicular portions of the mastoid muscle might also be adopted either for tying the inferior thyroid, or even the vertebral artery itself.

Fig. 85.

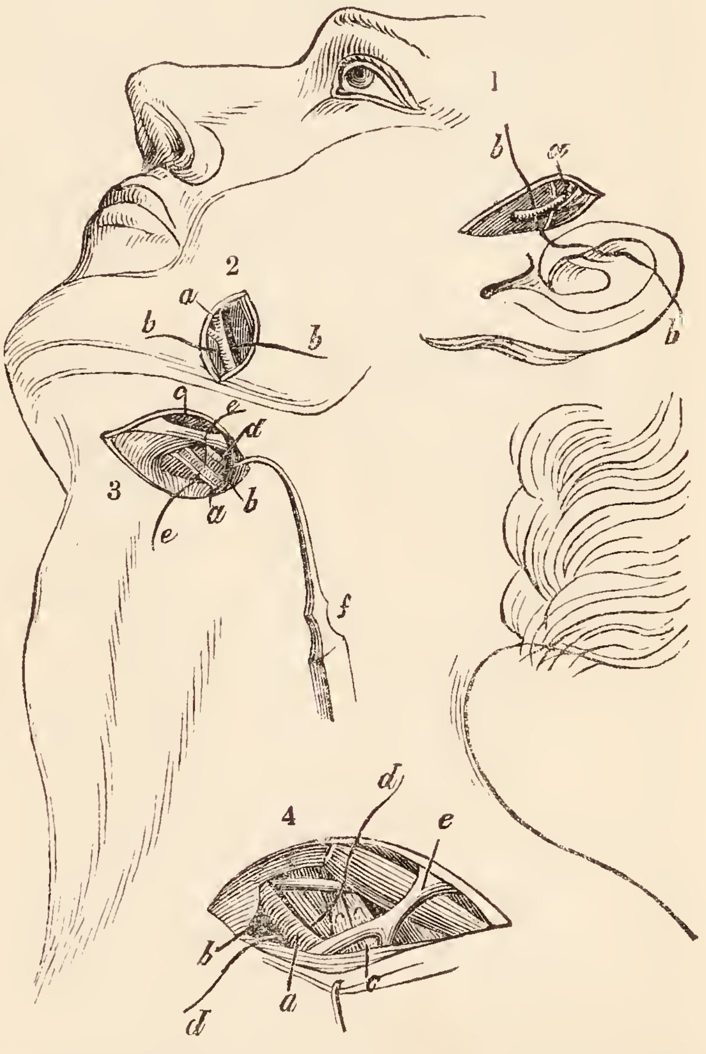

Fig. 85 *contains the temporal, facial, lingual, and subclavian arteries.*

No. 1. *The skin and temporal fascia having been divided, the temporal artery (a) is seen with its satellite vein; b b, the ligature passed under the artery.*

No. 2. *The skin and fascia covering the edge of the lower jaw are divided; the facial artery (a) with its satellite vein is seen ascending towards the angle of the mouth; a ligature (b b) is passed under the artery.*

No. 3. *The skin and platysma myoides are divided by a transverse incision. Beneath the hypoglossus muscle, which is also divided, are seen, a, the lingual artery, b, the vein, and d, the hypoglossal nerve; e, is a portion of the sublingual gland presenting itself in the upper edge of the wound; e e, the ligature passed under the artery.*

No. 4. *a, the subclavian artery; b, the vein to its inside; e e c, the nerves descending to form the brachial plexus; d d, the ligature passed beneath the artery; the nerves and artery are crossed by venous branches (c) which are descending to empty themselves into the subclavian vein. The subclavian vein and artery are separated by the scalenus muscle.*

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[1] Dr. Green, on the Varieties in the Arterial System.

Ligature of the superior thyroid: — This branch arises from the carotid, at or near its bifurcation; it takes a curved direction downwards, and inwards till it reaches the upper part of the thyroid gland.

The operation is the same as in cutting down upon the carotid itself, in the superior triangular space. It will be found accompanied by one or two small veins, between the carotid, and the lobe of the thyroid body, where it may be easily isolated.

Ligature of the facial or external maxillary and lingual arteries:—This branch of the carotid arises higher up than the superior thyroid, from which it is separated by another important branch, the lingual. An incision the same as for the carotid itself, should be made so that its middle would be just on a level with the cornua of the thyroid cartilage. As soon as the sheath of the carotid is laid open, the facial artery will be seen ascending obliquely upwards and inwards towards the lower jaw. The lingual artery will also be easily discovered running a little deeper, first in a horizontal and then in an oblique or vertical direction, between the os hyoides, and muscles of the tongue.

Another method has been proposed for tying the lingual artery. On reaching the upper part of the great cornua of the os hyoides, it lies close behind it, but it then ascends, advancing between the middle constrictor of the pharynx, and the hyo-glossus muscle, until it gets to the distance of nearly an inch from the body of the bone in front. The operation is performed in the following manner. The patient being placed on his back, the neck stretched and the face turned away, an incision of an inch or better in length, is made in the direction of the artery, above and parallel with the os hyoides. The skin and platysma myoides being divided, the facial vein is drawn backwards with a blunt hook. In the upper part of the wound the submaxillary gland is seen, its sheath having been opened; the digastric and stylo-hyoid muscles are also exposed; these being also held aside, the hyo-glossus muscle is discovered, beneath which the artery lies. This muscle must be divided with care, raising the fibres with a dissecting forceps, or dividing them on a director. It is easily isolated: the hyo-glossal nerve runs above it. (No. 3, fig. 85.)

This artery is mostly wounded in attempts at suicide; in those cases it may be tied on the surface of the wound. It gives origin to the ranine arteries, which lie at each side of the frænum. (See Ankyloglossum.)

ARTERIES OF THE HEAD AND FACE.

Ligature of the facial artery on the lower jaw: — The artery in this situation, lies in front of the edge of the masseter muscle, and being quite superficial, it can be easily felt pulsating upon the edge of the bone. The direction of the incision may be either horizontal or obliquely vertical. Beneath the fascia, the artery with its accompanying vein is immediately seen. (No. 2, fig. 85.)

Ligature of the temporal artery:—This vessel is easily found about three lines in front of the ear, and just above and behind the zygomatic arch. An incision, about an inch in length, will bring it into view; it is seen enveloped in a strong cellular sheath furnished to it by the temporal muscle. It can be isolated without difficulty. (No. 1, fig. 85.)

Ligature of the occipital artery.—Derived from the external carotid, this vessel passes below the upper portion of the digastric muscle, under the upper part of the mastoid muscle, and crosses the upper and back part of the neck. Its course is horizontal for about an inch, just below the ear and mastoid process. An incision drawn in this direction, and in a line with the edge of the lower jaw, will fall upon the artery; it is accompanied by a vein, and gives off several branches which intertwine with those of the vein. It is easily isolated. (No. 1, fig. 81.)

From the exposed situation of the arteries of the head and face, their aneurisms are chiefly of the traumatic kind. Spontaneous aneurisms have also been observed both without and within the cranium. Bégin relates a case in which an aneurism was formed in the middle meningeal artery. The bone having been absorbed, the tumour became superficial. It was mistaken for an encysted tumour, and extirpated. An ineffectual attempt was made to arrest the hæmorrhage by plugging; the patient however could not be saved. Mr. Hodgson mentions a case in which he found a small aneurismal sac in the anterior cerebral artery, which was filled with a solid coagulum; and another of the basilar artery has been observed by M. Serres. Sir A. Cooper found a small aneurismal sac on the central artery of the retina.

All the external branches have been also observed in divers instances to be the seat of spontaneous aneurisms, the aneurismal tumours presenting themselves in various points of the temporal, occipital, labial, and facial arteries; and M. Godichon has seen a case of aneurism of the frontal branch, in which the sac was as large as the thumb. Dr. P. H. Green has recently met with a case of spontaneous aneurism of the temporal artery.

If the aneurismal tumours that are developed within the cranium could be diagnosticated with certainty, as indeed they may be when the bone covering them has been removed by absorption, the proper remedy would be the ligature of the carotid artery of the same side. This proceeding is also generally preferred in the cases of external aneurisms that have proved rebellious to compression, excepting in the aneurisms of the facial and temporal arteries.

The cylindroid dilatation of these external vessels has been also observed. While recently on a visit to Glasgow, my friend, Dr. John M'Farlane of that city, showed me a case of this kind in a gentleman about twenty years of age, who had come from Cambelton to consult him. The dilatation occupied the superficial, temporal, and frontal branches: the vessels were very voluminous, soft, and extremely tortuous; and the wave of blood upheaving the mass could be very distinctly felt. The progress of the dilatation had been slow.

INFERIOR EXTREMITY.

Aneurisms of the inferior, are comparatively more frequent than those of the superior extremity; in the foot, however, as in the hand, they are of rare occurrence. It has been even doubted by some surgeons, if any case of aneurism of the dorsal artery of the foot has been ever observed. But though exceedingly rare, this form of the affection has nevertheless occurred. Guattani mentions a case that had been caused by the operation of blood-letting in the foot, and three other cases are recorded by MM. Roux and Vidal. From the position of the artery, and its resting on the astragalus, navicular, and cuneiform bones in its course, from beneath the annular ligament of the tarsus, at the upper part of the instep, to the point where it bifurcates, and dips down between the first and second metatarsal bones, compression will be particularly applicable. If, however, it should be found necessary to resort to ligature, it should be placed double, both above and below the tumour. Indeed this precaution becomes the more necessary as the aneurism happens to be more remote from the centre, in consequence of the more frequent communications that are established between the branches of an arterial trunk. This observation applies equally to aneurisms in the hand or on the head, and more especially, when the lesion of the artery is of the traumatic kind. The application of a single ligature above the aperture of the vessel, might, in such cases, be insufficient, as the blood would continue to reach the tumour, through the anastomosing branches.

Ligature of the dorsal artery of the foot:—In its course, it runs between the tendon of the common extensor, and the proper extensor of the great toe.

Fig. 86.

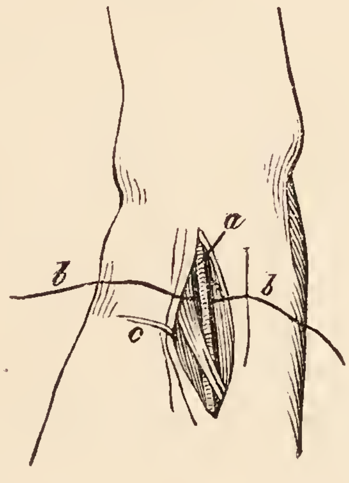

Fig. 86. *a, the dorsal artery of the foot between its two satellite veins; b b, the ligature passed under the artery; c, a retractor, holding back the external lip of the wound.*

The patient being placed on his back, the foot extended and slightly bent, is held by an assistant. An incision of an inch and a half or two inches is made from the tarsal annular ligament, along the outside of the proper extensor of the great toe. The division of the skin and cellular tissue exposes a thin aponeurosis which covers the artery itself. The vessel being isolated from its accompanying nerve and veins, a ligature is passed beneath it, and tied; if a second be necessary, it is applied in the same manner.

ARTERIES OF THE LEG.

Spontaneous aneurisms are extremely rare in the leg; those which require the intervention of the surgeon in this region, being chiefly of the traumatic kind. The arteries are derived from the popliteal, and are distributed on the front and back of the leg. The anterior tibial artery passes through an opening at the upper part of the interosseous ligament, and thus commences its course deep between the tibia and fibula, and lying on the interosseous ligament. It is covered by the mass of muscles, the tibialis anticus, extensor digitorum, and extensor pollicis; in the upper part of the leg, it descends first between the tibialis and extensor communis, next between the tibialis and extensor pollicis; on reaching the ancle, it passes beneath the annular ligament; deep-seated above, it gradually becomes more superficial throughout the rest of its course, resting in the lower part on the outside of the tibia. Its whole track corresponds with a line drawn from the middle of the space between the head of the fibula, and spine of the tibia, to a central point between the two malleoles. Its great depth above, and the proximity of the articulation below, are reasons for not tying it in either of these situations; the intermediate space being always preferred for this purpose.

Ligature of the posterior tibial artery:—This vessel is larger than the anterior branch, and may therefore, in consequence of its size and direction, be regarded as the continuation of the popliteal artery. It descends from the lower edge of the popliteus muscle, between the superficial and deep-seated muscles on the back of the leg. Its course would be represented by a line drawn from the centre of the hollow of the ham, to between the internal malleole and the tendo achillis; curving a little however towards the inside of the leg. Above it rests upon the posterior tibial muscle, and is deeply covered with the gastrocnemius and soleus; but the muscles becoming tendinous below, depart from the artery, so that it is superficial where it runs along the edge of the tendo achillis, being only covered by the skin and aponeurosis; it then descends behind the internal malleole, from which it is separated only by the tendons of the posterior tibial and common flexor muscles, enveloped in their sheath. Throughout this course, it is accompanied by two veins, one at each side, and the posterior tibial nerve, which lies to its fibular side. The artery may be cut down upon, at several points of this course.

Behind the internal malleole: — The leg being bent, and resting on its outside, and compression being made on the femoral artery in the thigh, or against the pubis, a vertical incision is made, about two inches long, midway between the malleole and the tendo achillis. This incision, which divides the skin and subjacent cellular tissue, runs for the first inch parallel to the tendo achillis, and then curves gently towards the sole of the foot. The aponeurosis, which is extremely strong, is now seen stretched between that tendon and the edge of the tibia ; this being divided cautiously with the point of a bistoury, or on a director, the next step is to pass the needle under the artery and secure it.

Fig. 87.

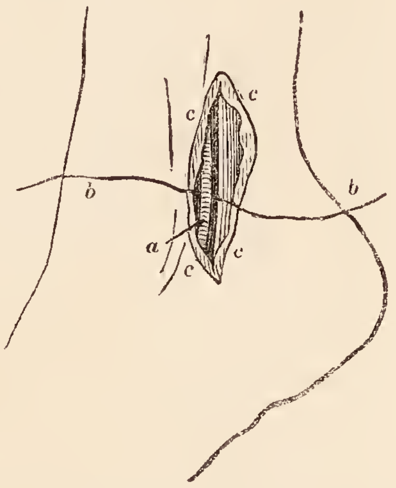

Fig. 87. *The posterior tibial artery (a), with its satellite veins, occupies the centre of the wound. b b, the ligature passed under the artery; c c c c, the section of the strong fascia which covers the vessels, and binds down the flexor tendons that pass behind the malleole.*

At the middle third of the leg, or between the ankle and the lower part of the calf:—In this situation the artery runs parallel to the tibia, and within half an inch of its internal border ; it lies in its own sheath, on the common flexor of the toes, and the long flexor of the great toe, covered by the fascia, adipose tissue, and integument. The incision in this operation must be between two or three inches long, running parallel with the internal border of the tibia. The aponeurosis covering the vessels being exposed, it should be divided with the usual precaution on a director. The artery and its two veins are then seen in the relation already described, the nerve also lying to its outside. When the incision is made closer to the tibia, there will be but one plan of fascia to divide, but there will be also the risk of not coming with so much certainty on the vessel. If the soleus should descend more than usual, it can be easily raised, as soon as the incision is made. The ligature is placed as before. (No. 2, fig. 88.)

Lisfranc recommends the incision to be made in an oblique direction, beginning at the inner border of the tendo achillis, and ascending, under an angle of 35 degrees to the inner border of the tibia. As soon as the integument and aponeurosis are divided, the soleus is detached from below, upwards, with the index finger, and the artery is thus exposed.

At the upper third of the leg: — In consequence of the depth at which the artery is situated, and the thickness of the soft parts, the incision should be at least from three to four inches in length, commencing about an inch behind the internal edge of the tibia, and descending parallel to that bone. The internal edge of the gastrocnemius is detached from the soleus, and raised in the posterior lip of the wound ; the fibres of the soleus itself are then divided longitudinally and to the same extent as the integuments. The interstice that exists between the soleus and tibialis posticus, and in which the artery runs, is recognized by the shining pearly appearance of the aponeurosis that envelopes the vessels. The course of the artery being oblique from above downwards, the higher it is taken in its course, the nearer will it be found to the middle of the leg. The muscular mass being retracted by means of a blunt hook, the aponeurosis is divided on a director, and the artery being isolated from the accompanying veins and nerve, the ligature is placed on the vessel. (No. 1, fig. 88.)

Fig. 88.

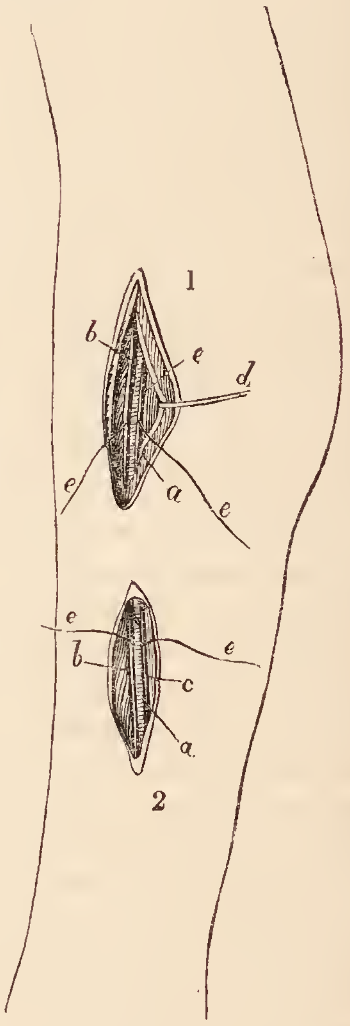

Fig. 88. No. 1. *The muscles of the calf are retracted, the white line seen on their border is a section of the strong fascia covering the soleus ; on the opposite side of the wound is seen the section of the fibres of the soleus itself. a, the posterior tibial artery, its satellite veins (c) running at each side of it ; d, blunt hook ; e e, the ligature passed under the artery.*

No. 2, *a, the posterior tibial artery between its two veins, b ; c, the nerve ; e e, the ligature passed under the artery.*

This operation is exceedingly difficult, both on account of the great depth of the artery, and the contraction of the large and powerful muscles of the calf of the leg. In one case, to obviate this excessive contraction, Bouchet of Lyons was obliged to divide part of their fibres, and Mr. Guthrie, in another case preferred cutting down on the vessel at once, directly through the thick of this muscular mass itself. If the saphena vein should lie in the line of the first incision, care should be taken not to wound it.

Sometimes the posterior tibial is altogether wanting, its place being taken by branches from the fibular, which is unusually large.—(*Green.*)

Ligature of the anterior tibial artery: — In cutting down upon this artery, the external border of the tibialis anticus will serve as a guide for the incision. In some subjects, this interstice can be rendered discernible to the touch, and even to the sight, by moving the foot so as to render the tendon of the tibialis prominent; in others, however, it is faint, and will require some pains to distinguish it.

Fig. 89.

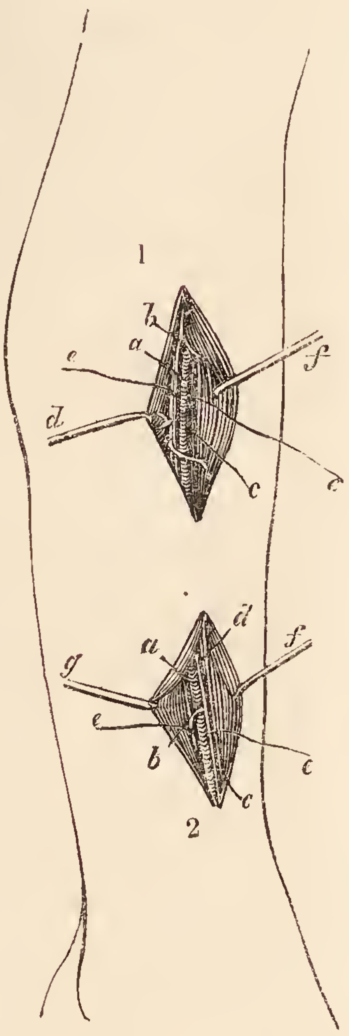

Fig. 89. No. 1. *Ligature of the anterior tibial artery at the superior-third of the leg. The skin and strong fascia being divided, the tibialis anticus is held against the outer side of the tibia by the retractor (f), the extensors of the toes are held back by the blunt hook, d. a, the tibial artery; b, the nerve; c, the satellite veins at each side of the artery; e e, the ligature passed beneath it.*

No. 2. *Ligature of the anterior tibial artery at the inferior-third of the leg. The same parts having been divided, the tendon of the tibialis anticus is held towards the tibia, and those of the extensors backwards by two hooks (g and f); the anterior tibial nerve (e), lies now to the tibial side of the artery (a); b, the satellite veins entwining upon it in front; e e, the ligature passed under the vessel.*

The patient is placed on his back, the leg and foot extended. As in all cases, where it is necessary to separate muscles, the surgeon should have the power of extending or relaxing them at pleasure. A vertical incision is made, extending three inches, or more if the patient be strongly built; the skin and cellular tissue are thus divided; the two muscles, the tibialis and extensor communis, if above, the tibialis and extensor pollicis if below, are then separated with the finger, or a blunt knife; or if any difficulty should be anticipated of falling on the muscular interstice, the incision may be made with a slight obliquity of direction. The artery with its accompanying veins is thus brought into view; the tibial nerve lying to the outside. When the vessel is cut down upon at the lower part of the leg, the nerve will be found at the inside, as it crosses the artery obliquely in its course from above downwards. If the depth be considerable, the isolation of the vessel will be facilitated by relaxing the muscles, and this facility will be still further increased by dividing transversely the strong aponeurosis which binds them down. The muscles should be relaxed as much as possible and held well asunder, otherwise the carrying the ligature under the artery will be found a matter of no small difficulty. In the lower part of the leg, the vessel lying in the midst of tendons, is much more accessible, and may be found by making an incision two inches in length, along the external edge of the tendon of the tibialis: the artery is soon discovered by separating the tendons which conceal it.

Peroneal artery: — The French surgeons describe the mode of cutting down on this artery. Its course from its origin from the outer side of the posterior tibial artery, at about an inch below the separation of the vessel from the popliteal is downwards towards the lower part of the fibula. Though at first of considerable size, it soon becomes so small as to fall beneath the size that would require the application of a ligature. If an aneurism were developed in the upper portion of this artery, most surgeons in this country would prefer placing a ligature at once, either on the popliteal or the femoral.

Fig. 90.

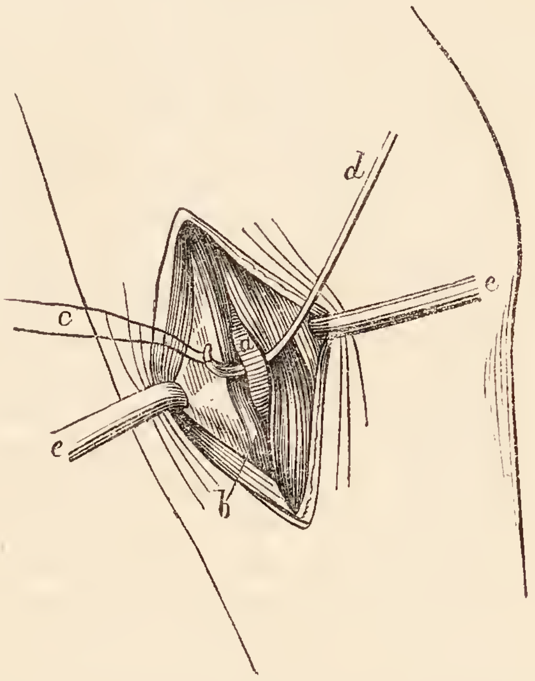

Fig. 90. *The muscles of the calf are retracted inwards, the flexor longus outwards; the vein and artery lie close together, the former to the outside. a, the peroneal artery raised on an aneurism needle (d); c, the ligature; b, the vein; e e, the retractors.*

The mode in which the ligature may be applied on the peroneal itself is described as follows: the artery is to be sought for about the middle of the leg, or a little lower, at the point where the soleus parts from the gastrocnemii. The incision should be two inches long, extending from the back of the fibula, to the external edge of the tendo achillis. The skin and aponeurosis being divided, the artery will be found on the inside of the flexor longus pollicis pedis. Mr. Guthrie, however, in a case of traumatic aneurism of the peroneal artery, preferred the method already mentioned, of cutting through the thickness of the calf of the leg, to placing his ligature on the femoral artery. The vessel may, it is true, be reached by either of these methods; but by that here described, the extent of incision will not be half so great.

For aneurisms of these several vessels, particularly if occurring near their origin, the popliteal artery itself may be cut down upon and tied.

This artery varies much in size, being influenced, in great measure, by the magnitude of the anterior tibial. Sometimes it does not exist as a distinct vessel, but its place is supplied by branches from the posterior tibial; sometimes its anterior branch is furnished by the anterior tibial, or in rare cases by a perforating branch from the posterior tibial.—(*Green.*)

POPLITEAL ARTERY.

This name is applied to the trunk of the inferior extremity from the point where the femoral artery passes through the tendinous attachment of the adductor and vastus externus muscles, to the lower edge of the popliteus muscles, where it divides into the arteries of the leg. The whole course of the vessel, which is directly downwards, with a slight inclination outwards, corresponds with the inferior fourth of the femur, and the superior fifth of the tibia. At first, it lies in the middle of the space, which is bounded by the biceps on the outside, and the semi-tendinosus and semi-membranosus on the inside; it then passes over the back of the knee-joint, between the two condyles of the femur, just before the notch that separates them, and then between the two heads of the gastrocnemius externus. The whole of this space is filled up with firm fat, in which the vessels and nerves are somewhat deeply imbedded, and in which are several small lymphatic ganglions. The artery itself lies deepest, the vein close upon it, but a little to its outer side, the nerve is the most superficial. On passing below the joint, the artery rises more towards the surface, and its relations with the vein and nerve become altered as these pass over it to get to its inside, or they divide, the artery occupying a central situation between both. In consequence of this greater proximity to the surface, the vessel is much more easy of access, where it passes between the heads of the gastrocnemius, a circumstance which may be turned to good account in operative surgery, as the ligature placed on the popliteal artery in this situation, will save very important articular branches for carrying on the circulation after its interruption in so considerable a trunk.

Ligature of the popliteal artery at its lower part:—The patient is made to lie on his belly, and the leg is held moderately extended. A longitudinal incision, corresponding with the line that separates the two heads of the gastrocnemii, is made in the median line, beginning just below the joint, and extending between three or four inches down the limb. The skin, cellular tissue, and fascia having been divided, the surgeon now lays aside the knife, and separates with his fingers the heads of the gastrocnemii. The popliteal artery is found, the vein and nerve, holding with it the relations already described. After the incision is made, the leg should be bent slightly on the thigh, in order to facilitate the exposure of the artery; care should also be taken not to wound the external saphena vein, should it lie in the line of the incision. The vein and nerve being drawn to the inside, the needle is passed beneath the artery from within, outwards.

Fig. 91.

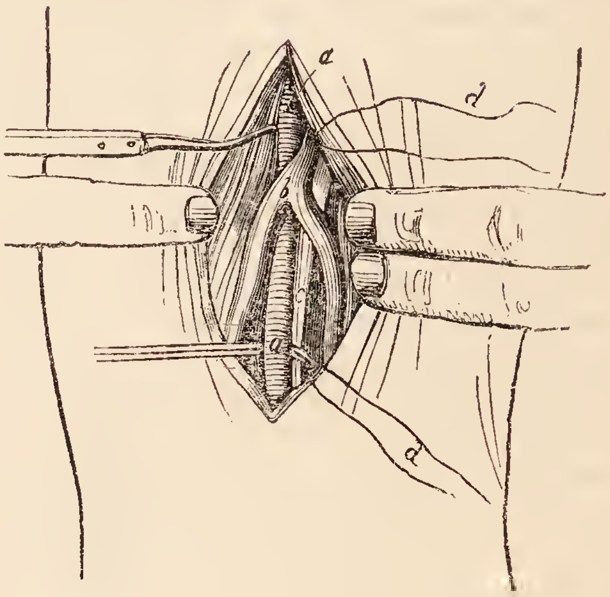

Fig. 91. *The lips of the incision being held apart by assistants, the semi-membranosus and biceps are seen under their fingers, the former to the inside, the latter to the outside. a a, the popliteal artery raised above on an aneurism needle, below on a flexible director, both armed with ligatures, d d; b, the popliteal vein receiving the posterior saphena vein; c, the popliteal nerve.*

By prolonging the separation of the gastrocnemii still further downwards, and dividing the firm aponeurosis of the soleus, the divisions of the popliteal artery also are rendered accessible to the ligature.

In wounds of the lower half of the popliteal artery, a ligature may be placed on any part of the upper half, either by enlarging the wound accidentally inflicted, or by cutting down upon it in the superior part of the hollow of the ham. The incision for this purpose should be very free, and should extend from the upper part of the popliteal space, and near to the muscles that form its internal boundary, in a slightly oblique line, down to its middle at the back of the articulation. The skin and aponeurosis being divided, the fat that fills up the hollow of the ham comes into view. This is torn or separated with the fingers, or a blunt knife. The nerve being the most superficial, presents itself first, the vein next, and then the artery. The isolation of the vessel is somewhat difficult, on account of its depth, and close connexion with the vein. In meagre patients the dissection will be proportionably less difficult.

POPLITEAL SPACE.

The great extent and depth of the popliteal space, affords room for the development of an aneurismal tumour, and hence it is that these tumours often attain a certain size before they become prominent in the ham. The strong aponeurosis also, with which the space is closed and bound down, resists powerfully their rapid growth. Owing to these circumstances, the aneurisms that occur in this region present at first a somewhat flattened appearance, enlarging gradually towards the sides, as the disease makes progress. The nerves, veins, and lymphatics are thus exposed to a considerable degree of compression, the normal relations of the bones and muscles are altered, the motions of the limb are impeded and painful, and there is infiltration of the leg and foot, with pain and numbness. In some instances this strangulation has proceeded so far as to disorganize the great nerves, and produce mortification of the limb itself; in others, the bones, cartilages, &c. have become eroded; the aponeurosis will, however, not unfrequently give way first, the aneurismal sac being then covered by the integument alone. Sometimes too, inflammation seizes on the whole tumour, and the aneurism is cured by being converted into an abscess.

Aneurisms occur frequently in the hollow of the ham, a circumstance which has been attributed by some surgeons to its vicinity to the knee-joint, where it is exposed to incessant flexion and extension. Flexion and extension however, so long as the coats of the artery are in a healthy state, will not cause an aneurism, and it is only when the tunics of the vessel have undergone some morbid alteration, that these become the occasional cause of its production. It has been observed to occur with comparative frequency in coachmen, jockeys, postillions, and drunkards.

Mr. Hodgson's plan of determining the frequency of aneurism in the different arteries has been followed out on a more extensive scale by Lisfranc. The following table exhibits the relative frequency of each in 179 cases of aneurism, those of the aorta being omitted:

1.	Popliteal	59
2.	Femoral at the groin	26
	Femoral at other points	18
3.	Carotid	17
4.	Subclavian	16
5.	Axillary in the arm-pit	14
6.	External iliac	5
7.	Innominata	4
8.	Brachial	3
9.	Primitive or common iliac	3
10.	Anterior tibial	3
11.	Gluteal	2
12.	Internal iliac	2
13.	Temporal	2
14.	Internal carotid	1
15.	Ulnar	1
16.	Peroneal	1
17.	Radial	1
18.	Palmar	1

Mr. Hodgson's table contains 63 cases, including, however, 29 of the aorta and innominata. The remaining cases are:

Carotid	2
Subclavian and axillary	5
Inguinal	12
Femoral and popliteal	15

The above tables embrace cases of spontaneous aneurism only.

It is but little more than fifty years since our best surgeons were afraid to place a ligature on such a large vessel as the popliteal. The idea, that by obliterating the main trunk, the mortification of the limb became inevitable, induced a belief that the aneurisms in this region, which had resisted the treatment by compression and debilitation, could only be treated by amputation; and when a case occurred, where success had followed the application of a ligature, its importance was explained away by attributing the fortunate result to some anomalous distribution of the vessels, furnishing other channels of supply. The capabilities of the collateral circulation were to a great extent unknown. In this region, the anastomosing branches, though small, are numerous, and the articular arteries instead of being insufficient, are much more likely to cause the return of pulsation in the aneurismal tumour, by the great force of the recurrent circulation, which soon becomes established through them.

Compression has been successfully resorted to in a certain number of instances, but they have not, however, been sufficiently numerous to permit the surgeon to be very sanguine of a favourable result, whatever be the mode of compression he may adopt. Neither should he rely on Valsalva's method, to the waste of valuable time. Under favourable circumstances, and where the patient is timid and young, refrigerants, compression, and debilitation may be had recourse to, separately or conjointly, and with advantage; but the surgeon should know when to desist: he should hazard nothing in favour of a remedy which, though more tolerable to the imagination of the patient, is at the same time less efficacious and less certain than that which he looks upon as a dernier ressort.

These aneurisms, however, like all others, are sometimes cured spontaneously; and more than once, patients admitted into hospitals for the purpose of undergoing the operation, have been dismissed cured, without the intervention of any other means than rest and simple bandaging.

Before Hunter's time, when the ligature was had recourse to, the mode employed was to place one, both above and below the tumour, according to Keysler's plan, and emptying it of the coagulum. In this country, a plan so dangerous was soon supplanted by the Hunterian operation. In France, however, it was continued until a comparatively recent period. Boyer was one of the last of its defenders.

Neither Brasdor's nor Mr. Wardrop's methods have been as yet employed in these cases; but it is the opinion of some very good authorities, Velpeau among others, that where the tumour is still small, and has not produced extensive disturbance, and that it is situated so high in the ham as to leave a sufficient portion of the vessel below the articulation to allow room for placing a ligature, that one or other of these methods might be tried with a fair prospect of success.

FEMORAL ARTERY.

Emerging from the pelvis, this vessel passes under Poupart's ligament, and enjoys the name of femoral, until it reaches the opening through which it penetrates the adductor. Its course would be represented by a line drawn from the centre of the crural arch, and passing obliquely downwards, till it gets quite behind the femur, towards the notch that separates its condyles. In this course, it gives off some important branches. The artery may be tied, either above or below the middle of the thigh, or indeed at any point of its course. The aponeurosis, so frequently alluded to, as covering the arteries in other situations, here assumes the form of a sheath, which extending from Poupart's ligament to the opening in the adductor, envelopes both the femoral artery and vein. The sartorius muscle, as it crosses the thigh obliquely from above downwards, lies at first to the outside of these vessels ; it then covers their sheath as a riband, and lastly, gets to the inside of them long before it reaches the inner border of the ham. In relation to this muscle, therefore, the great femoral vessels may be said to occupy three different situations, as they are found on the inside, beneath, or on the outside of its course. The saphena vein, which may be seen ascending on the inside of the thigh to dip into the femoral vein at its upper part, lies somewhat backwards as regards the course of the artery.

Fig. 92.

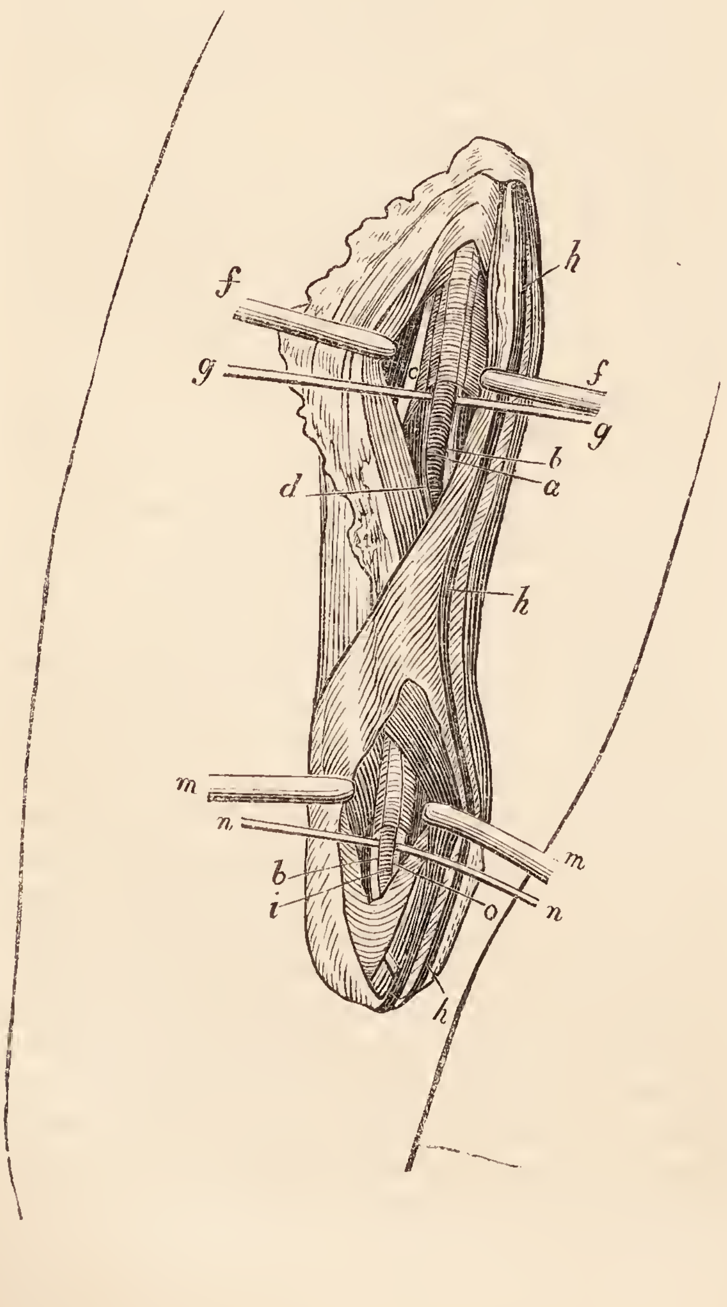

Fig. 92 *exposes the femoral artery at two different points; the superior third, and the inferior third of the thigh.*

Above, the skin, cellular tissue, and superficial fascia having been divided, the sheath of the femoral vessels, in part laid open and in part still covering the vessels, is seen. Along the inner border of the wound, and parallel with the edge of the skin, the saphena vein is seen ascending, throughout its entire length. On the opposite side the internal edge of the sartorius is retracted. a, the femoral artery raised on a director (g g); b, the femoral vein; e, the crural nerve; a satellite nerve (d) is also seen running alongside the artery; f f, the retractors; h h h, the saphena vein.

Below, the same parts are exposed; the division of the sheath of the vessels is prolonged, to show the passage of the femoral vessels backwards into the popliteal space. m m, the retractors holding the aponeurotic insertion of the vastus internus to the outside, and the anterior edge of the sartorius to the inside. The artery is raised on the director (n n); i, the crural nerve; o, the vein; b, the artery; h, the saphena vein.

In the superior division, the femoral vessels are lodged in a triangular space, the base of which is formed above by the border of Poupart's ligament, its internal border by the pectineus and adductor longus muscles, the external by the sartorius. In this space they are only covered by the skin, fascia lata, fat, in which the lymphatic glands lie scattered, and their own sheath, and consequently are more superficial than in any other part of their course. In this space too, the great saphena vein empties itself into the femoral vein, which lies on the internal or pubic side of the artery ; the anterior crural nerve is on the opposite side, and a little distant from it.

The artery becoming deeper seated, disappears in the apex of the triangular space above described, beneath the sartorius muscle.

In the third or lowest division, the sartorius lies to the inside of the artery until it passes close upon the bone, between the adductors longus and magnus ; and here the sheath of the vessel is exceedingly strong and fibrous.

Ligature of the femoral artery in the upper third of the thigh :—As the operation is now more frequently performed on this than on any other portion of the artery, we shall describe it first ; and as the branches given off from the main trunk are very important, they may be briefly enumerated. Both the epigastric and circumflex arteries are sometimes given off from the femoral, just below Poupart's ligament. The profunda, a large vessel, sometimes nearly equal in size to that of the femoral itself, arises from it, at about an inch and a half or two inches below Poupart's ligament, or about midway between the pubis and the level of the trochanter minor. The other branches, though unimportant as regards the placing of a ligature, are by no means so in respect to the supply of blood to the limb after the main trunk is tied.

The femoral artery is most commonly tied at an inch or two below the profunda, as a sufficient space should be left between that vessel and the ligature to allow of a coagulum being formed. The course of the saphena vein should be clearly ascertained before making the incision, as a wound of it, might, under some circumstances, prove highly dangerous. The patient lies on his back, with the thigh gently bent, and inclined outwards.

The pulsations of the artery having been felt as low down as the point where they become masked by the sartorius, an incision of about three inches in length is made in the line of the artery, beginning below the origin of the profunda, or about four inches below Poupart's ligament. The skin and cellular tissue being divided, the internal edge of the sartorius is seen ; this being raised, a director is passed under the fascia, in order that it may be cautiously divided. The femoral vessels in their sheath will then be exposed. The point of the blunt knife, or even that of the bistoury with due care, may be employed to lay open the sheath, to the extent of an inch or more. The needle is then passed from within outwards, the vein being to the inside and rather behind, and the nerve being to the outside of the artery.

In wounds of the femoral artery, in this region, or of the profunda, as well as in spontaneous aneurism occurring high up, the vessel may also be secured between the epigastric artery and the profunda. The mode of arriving upon the sheath would be precisely the same as that just described. The ligature should be placed close above the profunda to leave as much space as possible between the ligature and the epigastric and circumflex arteries. The sheath here contains only the artery and vein, the latter a vessel of some size, and coming on the inside, somewhat in front of the artery ; the nerve lies at some distance on its outside.

Ligature in the middle of the thigh:—In this situation, the femoral artery has not yet reached the tendinous canal through which it passes into the popliteal space. It was upon this portion of the femoral artery, that Hunter first applied the ligature for the cure of a popliteal aneurism. He made his incision on the inner part of the thigh, rather below its middle, continuing it obliquely across the inner border of the sartorius muscle. At the present day, the outer edge of this muscle is preferred for the line of the incision, both because the vessel is thereby more easily exposed, and the saphena vein is less likely to be injured. Some surgeons recommend a middle course ; that is, to cut along the middle of the sartorius, and then to include it, either in the anterior or posterior lip of the incision, as circumstances may render it most desirable. If the surgeon is operating close upon the point where the artery is about to pass through the abductor to become the popliteal artery, his incision must then be on the outside of the sartorius. If this muscle should interfere too much with the facility of accomplishing his object, he should not, as Desault advised, divide it ; enlarging the incision will answer every purpose. But the decided preference given to the operation on the superior division of the artery has greatly diminished the importance of these remarks.

The incision should be at least three inches long, corresponding with the space that marks the separation between the outer edge of the sartorius and vastus internus. In some subjects, this line is not distinct, and it is therefore safer to cut a line or two within the external edge of the sartorius, so that its fibres may be exposed as soon as the cellular tissue and fascia are divided ; it will be thus easy to get to its posterior surface, and detach it from the thigh, by including it in the posterior lip of the wound. By following the cellular interstice, the sheath of the vessels is easily found. On account of its great strength, some care must be taken in opening it. The best way is to scratch a small aperture through which the grooved director may be introduced, and then it may be safely slit open. The vein lies on the inside, the nerve to the outside, of the artery ; its isolation from the vein is here a task of some delicacy, as they are connected by dense cellular tissue. During the whole time of the operation the limb should be gently bent, and as much relaxed as possible. The dissection will be the more easy on this account. The needle should be passed beneath the artery from within, outwards, leaving the vein to the inside. An assistant should be stationed in such a position as to be able in an instant to command the artery, by pressing it against the pubis, in case it should unfortunately happen to be wounded during the operation.

The femoral artery had been tied in cases of wounds of this vessel, long before the establishment of the principle which has governed this operation since the days of Hunter, namely, the placing the ligature on a sound portion of the vessel, and at a certain distance above the aneurismal tumour. Cases had also been recorded, where the aneurismal sac having been attacked with gangrene, the coagula and sloughs were thrown off, and the patients were cured ; the femoral artery becoming obliterated. Guattani mentions a case of inguinal aneurism, which was as large as the first ; it became gangrenous, and the femoral artery was obliterated for a considerable extent from the crural arch downwards. The patient was exhausted by the suppuration which followed the detachment of the eschars ; but there was no deficiency in the supply of blood to the limb, notwithstanding the obliteration of the main trunk. A similar case is mentioned by M. A. Severinus ; the patient recovered perfectly. Saviard mentions a case, in which Bottentuit, in the year 1688, placed a ligature on a wounded femoral artery in the Hôtel Dieu with complete success. The surgeons who were called in consultation, he states, although they were of opinion that nothing but the ligature of the wounded vessel could save the patient's life, were fearful that he would perish from loss of blood before the opening of the artery could be found, and even though the vessels were secured they were still apprehensive that the obstruction to the circulation would be followed by mortification of the limb. Indeed so convinced were they of the desperateness of his condition, that they had the sacrament administered to him before the operation was attempted. After the ligature was placed and tied firmly, the additional precaution was taken of keeping constant pressure on the vessel by a succession of assistants for twenty-four hours. The patient had quite recovered in six weeks, and subsequently went through several campaigns. Severinus was equally successful in another case in which he applied a ligature to the femoral artery, for a wound of that vessel caused by a musket-ball: he tied it both above and below the wound.

In spite of these examples, however, and of the success attending the application of the ligature on the brachial artery, the same apprehensions as regards the mortification of the limb continued to prevail. The powers of the collateral branches to furnish a sufficient circulation continued to be overlooked, until Winslow and Haller produced their illustrations of the numberless anastomoses whereby the circulation may be continued between the upper and lower parts of the limb, after the obstruction of the main trunk. In popliteal aneurism, Haller asserted that if the course of the blood were intercepted in the popliteal artery between the origins of the upper and lower articular arteries, these arteries through their communications would be sufficient to carry on the circulation in the leg. Heister was so convinced of the soundness of the conclusion drawn from the foregoing facts and observations, that he proposed in 1744, the ligature for aneurism of the popliteal artery, to be applied in the same manner, as previously to that time it had been employed on the brachial artery. In Haller's *Disp. Chir.* Guenaud, adopting the same views, loudly condemns the practice of amputating for popliteal aneurism. Before this period, however, it would appear from a letter written by Testa to Cotugno, that Keysler, a German surgeon, had in many cases employed the ligature. Lochman, a French surgeon, operated in this way successfully at Florence in 1752, as did Birchall at the Manchester infirmary in 1757; and from this period it began to be practised in Italy under the auspices of Guattani and Magotti. The latter placed a ligature both above and below the tumour, and emptied it of its contents. It was in this way that the operation was subsequently practised in France by Chopart in 1781, unsuccessfully, and afterwards in two cases by Pelletan successfully. It would appear, from the works of Pott, Wilmer, Kirkland, and others, that this method had been employed on many occasions in this country prior to this period. From the severity of the operation itself, however, and the unsatisfactory nature of its results, it had gradually fallen into disuse.

The precepts and practice of Hunter, opened a new era in this department of surgery; and the timidity which had so generally prevailed amongst the surgeons of the preceding age, was now completely dispelled. As the share which Hunter had in this memorable change has been claimed for others, a few observations on this point may not be unacceptable.

It has been affirmed by some French writers, that the merit attaching to the introduction of the Hunterian operation, belongs to Anel. Lisfranc, who, in his Treatise on the Different Methods of producing the Obliteration of Arteries, has taken some pains to clear up this point, shows that the first known method for the treatment of aneurism has been entirely overlooked by every writer on the history of this affection. This method belongs to Rufus, and is thus described by Ætius: *Si vas unde emanat sanguis profundum fuerit . . . , ubi situm ejus et magnitudinem diligenter perspexeris, noverisque numquid vena sit an arteria,* VAS IMMISSA VOLSELLA EXTENDEMUS, ET MODERATE CIRCUMFLECTEMUS. *Ac ubi ne sic quidem cessaverit vinculo constringemus; nonnunquam et post vinculi nexum oblique vas incidere cogimur.*[1] This quotation proves, that not only was the idea of employing the simple ligature then known, but even that the torsion of the vessel which has been of late years described as an invention of modern surgery, was then recommended.

Ætius himself describes another method, which he put in practice for an aneurism at the bend of the arm. He discovered the artery at four fingers' breadth below the axilla, and applying two ligatures, he then cut the vessel across between them; he next emptied the aneurismal sac completely, and tied the artery at this point *sicut priorem*, an expression which, according to the interpretation of M. Dézeimiris, seems to say that he also applied two ligatures upon the artery below the tumour.

Paul of Egina's method of treating spontaneous aneurism, *si ex arteria dilatata tumor obvenerit,* was to expose the vessel by a longitudinal incision, and by means of a needle, pass a double ligature under it, previously plunging a bistouri into the tumour. Though the text is somewhat obscure, it may very naturally be supposed that the ligatures were placed above and below the tumour, and that the sac was opened between them. Here then, observes Lisfranc, is a proof that the method chiefly followed during the 18th century, may be traced back to Paul of Egina.

Avicenna mentions the simple ligature for the wounds of arteries, judiciously recommending that it should be applied between the wound and the heart; and adds, that if the blood should issue from the inferior portion of the wounded vessel, that a second ligature should be applied.

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[1] Ætius, lib. xiv. cap. 52.

Paré, speaking of an aneurism near the shoulder-joint, which had been imprudently opened by a barber, gives the following advice: "Partant je conseille au jeune chirurgien, qu'il se garde d'ouvrir les aneurismes, si elles ne sont fort petites, et en parties non dangereuses, coupant le cuir au dessus, le séparant de l'artère; puis on passera une esguille à séton, enfilée d'un fort fil, par sous l'artère aux deux costés de la plaie, laissant tomber le filet de soy-même, et ce faisant, nature engendre chair qui sera cause de boucher l'artère[1]."

Guillemeau, a pupil of Paré, gives an account, in the following words, of the operation he performed on the son of M. Belleville: "Auquel après une saignée faite au ply du bras, lui était survenu un petit aneurisme, qui par succession de temps était accru de la grosseur du poing, auquel enfin le sang contenu en iceluy se groumela; ce qui fut cause d'engendrer quelque commencement de pourriture en ladite tumeur, comme il s'aperçut par le cuir qui avait changé sa naïfve couleur en noirceur et lividité, *estant même altéré et ouvert;* pour à quoi obvier et au grand flux de sang principalement qui s'en pourrait suivre, avec deperdition d'esprits, si l'ouverture se fesait plus ample, je proposai aux médecins et aux chirurgiens le seul remède pour obvier à ce mal, qui était de lier l'artère plus haut que l'aneurisme qui était au ply du bras, à laquelle opinion enfin chacun s'accorda. Premièrement je remarquai sur le cuir l'artère en la supérieure et intérieure partie de l'avant-bras, ainsi qu'elle descend de l'aisselle au ply du bras, trois doigts au dessus d'icelui; et en cette même partie suivant ce que j'avais remarqué, je fis une légère incision en long au cuir, qui était comme séparé à l'endroit de l'artère où elle se rencontre au toucher, et l'ayant ainsi découverte, passai par dessous avec une grosse esguille courbe une petite fisselle desliée, puis avec icelle fisselle je liai ladite artère à double nœud. Cela fait, tout le sang groumelé et autre caillé contenu en la tumeur fut ôté, puis les parois de la tumeur furent lavées avec eau-de-vie à laquelle j'avais fait dissoudre un peu d'Egyptiac pour corriger la pourriture, ja commencée en cette partie; un mois après le malade fut parfaitement guéri sans être aucunement estropié; de quoi j'ai été infiniment esmerveille."

The operation which Anel performed a century later, differed from Guillemeau's only in regard to the sac being left untouched; but in both, the ligature was placed on the vessel just above the sac, and it appears that Guillemeau did not by any means consider the emptying of the sac as an essential step of his operation, since he adds to his description of it, "Si en quelque autre partie extérieure il se présente au chirurgien pareil aneurisme, il peut sûrement découvrir le corps de l'artère vers sa racine et partie supérieure et la lier de même façon *sans autre cérémonie*[2]."

Now, on neither of these occasions was the principle involved in the Hunterian operation as much as hinted at. The surgeons of the 17th and 18th centuries did not possess that knowledge of the diseases of arteries, which might have led to the adoption of so important an improvement as that with which the name of Hunter is irrevocably identified. Nay, the case operated upon by Dessault in 1785, cannot even be quoted as an illustration of the principle, for Dessault operated on the *popliteal* artery, just above the tumour, as did Guillemeau and Anel on the brachial artery. Hunter tied the *femoral* artery for popliteal aneurism. In so doing, his purpose was obvious: he was aware that the disease in the coats of the artery, upon which the formation of the aneurismal tumour depended, often extended for some distance along the vessel, and he therefore placed his ligature at a distance above the tumour, in order that it might bear upon a sound portion of the arterial trunk, well knowing that the contents of the aneurismal sac might be absorbed. The question therefore is not one of dates, but of facts, and the difference between the two modes of operating, which on one side have been gratuitously assumed to be identical, may be thus summed up: Anel's operation, performed at the beginning of the 18th century, preceded Hunter's by seventy years, led to no result, and was all but forgotten; Hunter's led the way to some of the most brilliant achievements of surgery, and changed the whole practice of our art in regard to this particular class of diseases.

In the thigh, as in other situations, aneurisms have been known to undergo the spontaneous cure, the tumour either inflaming and suppurating, or the sac becoming converted into a fibrous knot, without any apparent inflammatory symptoms. Instances might be collected, in which these favourable terminations of spontaneous aneurisms have been observed to take place, either with or without local treatment, such as the application of ice, evaporating or astringent lotions, leeches, &c. Even wounds of the femoral artery have been known to undergo the same process of cure. Larrey speaks of a serjeant of the guard, who, in 1817, had a sword wound in the upper part of the right thigh; a circumscribed false aneurism was the consequence; he was however, soon cured by Valsalva's treatment combined with cold local applications.

Compression has also been employed, with now and then a favourable result. Guattani succeeded in obliterating the femoral artery, by keeping up pressure upon it against the branch of the pubis. Brasdor's method has also been employed on the femoral artery in inguinal, or rather iliac aneurism, but without success.

In whatever part of its course the femoral artery may be tied, the collateral circulation unless it shall have been extensively obliterated, will be found sufficient for the nourishment of the limb. In some cases even the tumour has been observed to pulsate anew at some interval after the ligature had been applied. The instances mentioned by Pott and Guerin, in which the popliteal tumour continued to increase after the ligature had been applied, do not, as was then supposed, prove that the ligature had not been placed on the vessel. We now know that the recurrent circulation may be sufficient to renew the pulsation of the tumour; but compression and rest, in these cases, will in general be found successful. Monteith of Glasgow mentions a curious case of aneurism in which two months after the femoral artery had been tied the tumour had become much reduced in bulk, and all but consolidated; in this case however the pulsations returned, and the tumour began again to increase. It was checked and ultimately cured, without a second ligature, by the means just mentioned.

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[1] A. Paré, liv. vii. c. 34. De l'Aneurisme.

[2] Guillemeau, p. 699.

Fig. 93.

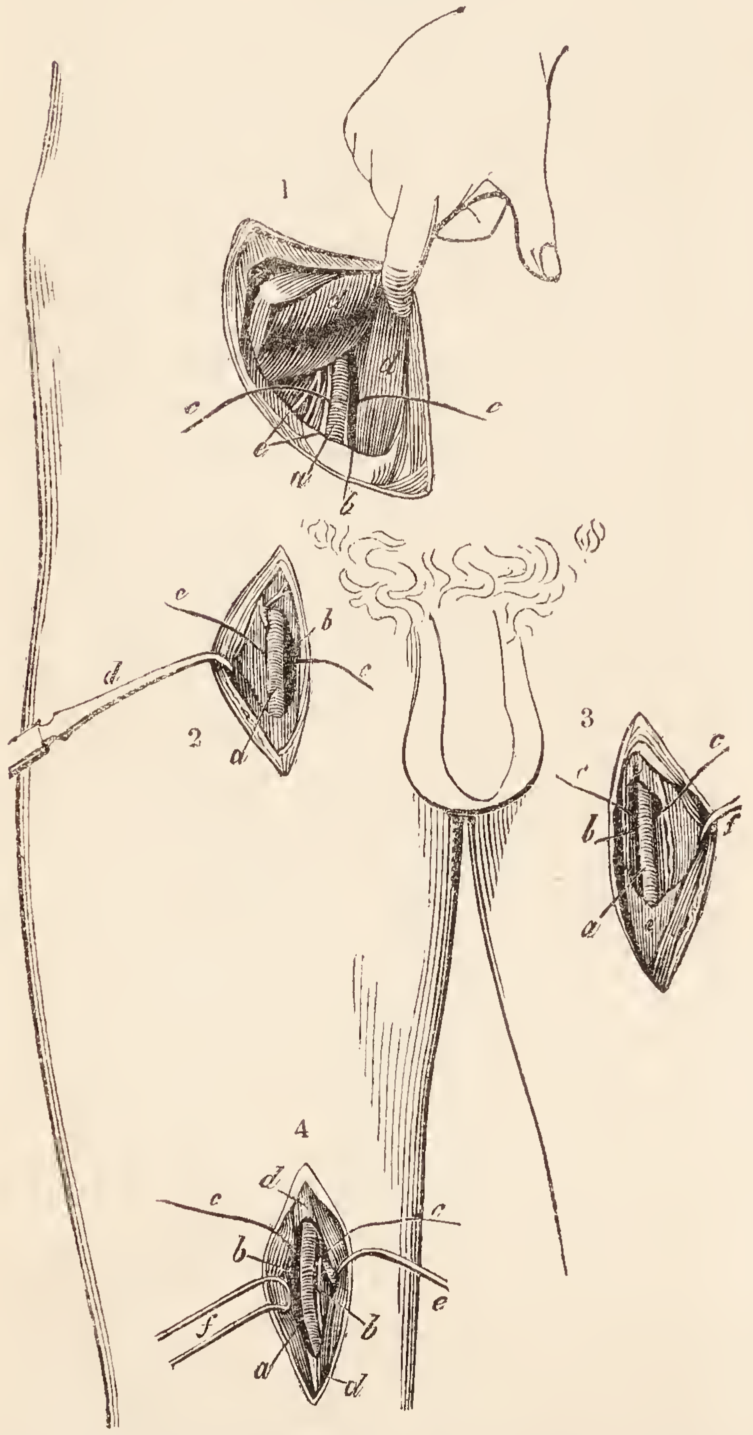

Fig. 93 *shows the operations for tying the external iliac artery and the femoral artery at three different points.*

No. 1. *The lower edge of the abdominal muscles having been divided, and the peritoneum detached from the iliac fossa, both are raised upon the fingers of the assistant. a, the external iliac artery; b, the vein lying to its inside; c c, the ligature passed under the artery; d d, the bag of the peritoneum; e, branches of the lumbar nerves, crossing the iliac fossa on the outside of the artery.*

No. 2. *The femoral artery, just below Poupart's ligament, is seen giving origin to the circumflex. a, the artery; b, the vein to its inside, and in the same sheath; c c, the ligature passed under the artery; d, a blunt hook retracting the outer lip of the wound.*

No. 3. *Ligature of the femoral artery at the place of election, close upon the point where it passes under the internal border of the sartorius. a, the artery: b, the vein; c c, the ligature passed beneath the artery; f, a blunt hook, retracting the outer lip of the wound. The sheath of the femoral vessels is laid completely open, to show the relative position of the artery, vein, and nerve. The same extent of opening would be not only unnecessary, but improper in the operation for tying the vessel.*

No. 4. *The femoral artery is here exposed at the point where it is about to become the popliteal. The external edge of the sartorius is carried to the inside of the thigh, the vastus internus to the outside. a, the artery; b, the vein; c c, the ligature passed beneath the artery; d d, the sheath of the vessels fully laid open; e, and f, a blunt hook and retractor.*

EXTERNAL ILIAC ARTERY.

The common or primitive iliac arteries from their origin at the bifurcation of the aorta, give rise to several important vessels, which supply the internal and external parts of the pelvis, and the lower extremities. The common iliac extends in direction downwards and outwards from the middle of the fourth lumbar vertebra to the sacro-iliac symphysis; at this point, it divides into the internal iliac which descends at once into the pelvis, and the external iliac, which, coursing along the brim of the pelvis, passes outwards and downwards under the middle of Poupart's ligament, there to become the femoral artery. In this course it runs parallel to the internal border of the psoas muscle, having the iliac vein to its inside and somewhat behind it. The anterior crural nerve lies to its outside, and separated from it by the psoas muscle; another small nerve lies either on the front of the artery, or between it and the vein. It is bound down in its situation by the iliac fascia which forms its sheath, and the lymphatics ascending under Poupart's ligament entwine themselves on its surface. It is crossed by the spermatic vessels, and the whole is covered by the peritoneum, which is united to these several parts by loose cellular tissue. In passing under Poupart's ligament, it gives off the epigastric and circumflex arteries.

Ligature of the external Iliac Artery:—This operation was first performed by Abernethy in 1796, on a patient who had had two aneurisms in succession, the first of the popliteal artery, which was cured by the Hunterian operation; the second of the femoral artery of the opposite limb, high up in the groin. Abernethy first placed a ligature on Brasdor's plan, on the artery below the tumour. Hæmorrhage came on the fifteenth day after the operation, and as a last resource, he immediately resolved to tie the iliac artery itself. He accordingly made an incision in the abdominal integuments, and in the line of the artery, of about three inches in length. The aponeurosis of the external oblique was thus laid bare, and divided from Poupart's ligament in the direction of the external incision. He next passed his finger beneath the margins of the internal oblique and transversalis, and divided them upon it, the finger protecting the peritoneum. He was then at liberty to detach the peritoneum, and reach the vessel. After separating the artery from the vein, he passed a ligature carefully around it, and tied it as high as an inch and a half above Poupart's ligament. In another case in which Abernethy operated, he made his incision, not upon the line of the artery itself but somewhat more externally, in order not to wound the epigastric artery. As he adhered to this method afterwards, it will perhaps be proper to describe it more particularly.

The patient is made to be somewhat inclined to the side opposite to that on which the operation is to be performed, in order to relax the abdominal muscles covering the tumour, and diminish the pressure of the intestines upon that side. An incision is then made half an inch to the outside of the abdominal ring, beginning just above Poupart's ligament and ascending somewhat obliquely in the direction of the artery to the height of three inches. The aponeurosis of the external oblique having been divided, the index finger of the left hand is introduced beneath the lower border of the external oblique and transversalis ; a concave bistoury is then guided on the finger, and they are divided to the extent of an inch and a half. The peritoneum is then cautiously detached until the pulsations of the artery are felt ; its isolation and ligation are then effected as already described, care being taken to carry the point of the needle from within, outwards, in order to protect the vein from injury.

Fig. 94.

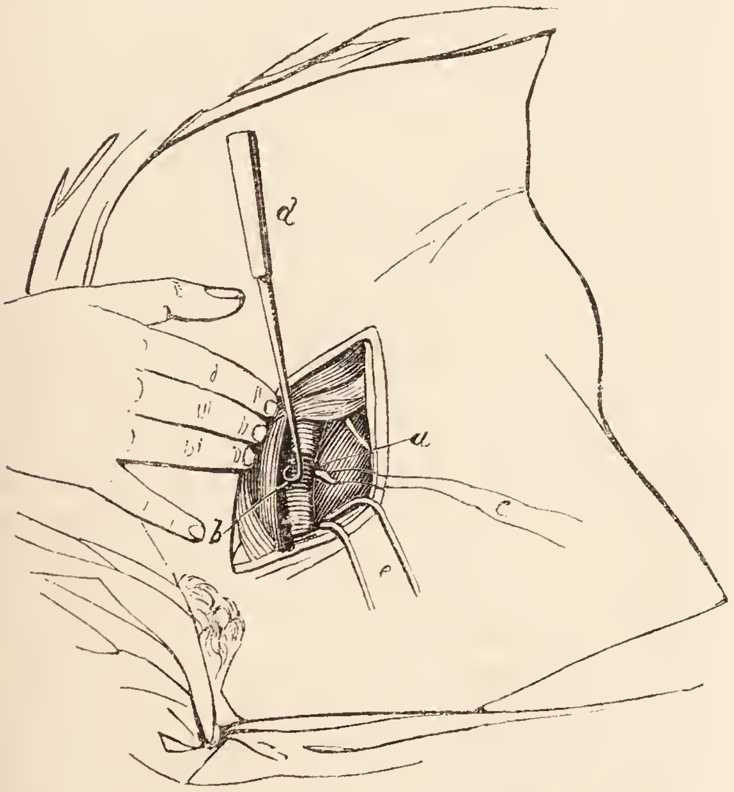

Fig. 94. *Mr. Norman's plan for making the incision for placing a ligature on the external iliac artery. The superior lip of the wound is held open by an assistant, who sustains the abdominal viscera at the same time. The skin, muscles, and a fold of the peritoneum are thus held up. The lower lip is also retracted, exposing the external iliac fossa, upon which one of the lumbar nerves is seen. a, the external iliac artery raised on an aneurism needle, d ; b, the external iliac vein ; c, the ligature ; e, a retractor. The epigastric artery is given off from the inner side of the vessel at the inferior angle of the wound, where it may be tied in case of accident ; a small nerve also accompanies the artery, which should not be included in the ligature.*

Sir A. Cooper's method is somewhat different, and is thus described by Mr. Hodgson. " A semilunar incision is made through the integuments in the direction of the fibres of the aponeurosis of the external oblique muscle. One extremity of this incision will be situated near the spine of the ilium ; the other will terminate a little above the inner margin of the abdominal ring. The aponeurosis of the external oblique muscle will be exposed, and is to be divided throughout the extent, and in the direction of the external wound. The flap which is thus formed being raised, the spermatic cord will be seen passing under the margin of the internal oblique and transverse muscles. The opening in the fascia which lines the transverse muscle through which the spermatic cord passes, is situated in the mid-space between the anterior superior spine of the ilium, and the symphysis pubis. The epigastric artery runs precisely along the inner margin of this opening, beneath which the external iliac artery is situated. If the finger therefore, be passed under the spermatic cord, through this opening in the fascia, it will come into immediate contact with the artery, which lies on the outside of the external iliac vein. The artery and vein are connected by dense cellular tissue, which must be separated, to allow of the ligature being passed round the former."

Mr. Norman of Bath, who has operated according to both modes, has the following judicious appreciation of them. " The objection to Sir A. Cooper's mode of operating in cases where the tumour extends high up, is by no means well founded ; for the lower part of the bag of the peritoneum, lying on the edge of Poupart's ligament, must in every case be exposed and detached, in order to get at the artery, which lies behind the posterior part of that membrane, and this is most easily effected by an incision in the direction of Poupart's ligament ; whilst two thirds of the longitudinal incision are made on a part of the peritoneum, which lines the abdominal muscles, and the lower portion only of the incision reaches that part of the membrane, which is to be separated. The consequences of this are, that the peritoneum is in much greater danger of being wounded, and that the probability of a hernia forming after the cure, is much increased by the extensive division of the oblique muscles." (*Med. Chir. Trans.* vol. x. p. 101.)

Another modification of this method was proposed by Bogros, who had so much distinguished himself in his short but brilliant career as *Chef de travaux anatomiques* to the Faculty of Medicine of Paris. He made an incision, just above Poupart's ligament about two or three inches long, the extremities of which were about the same distance from the spine of the ilium on the outside, as from the angle of the pubis on the inside. This brought into view the aponeurosis of the external oblique, which was divided on a director, to the same extent as the external incision, and parallel to Poupart's ligament. The slight connection of the cremaster muscle with the femoral artery was then broken up with a blunt knife, and both the muscle and the spermatic vessels were carried towards the pubis. The *fascia transversalis*, with the opening through which the spermatic cord passes into the inguinal canal, then presents itself. This opening is dilated with the finger, until the epigastric artery, which lies just behind it, is exposed. Following this artery with the finger towards its origin, the iliac artery is easily discovered.

During the whole time of the operation, but more especially after the muscles have been divided, the walls of the abdomen should be kept perfectly relaxed, and the patient should avoid any sudden movement, or effort, as otherwise the peritoneum may be wounded.

Each of these methods has its advantages and disadvantages. Abernethy's first method is reproached with an extensive and unnecessary exposure of the peritoneum, which on the other hand is compensated for, by the facility which it gives for reaching and tying the vessel. Those of Sir A. Cooper, Mr. Norman, and Bogros, in which the wound is prolonged, it is said uselessly, towards the spine of the ilium, expose less to lesion of the epigastric artery, and to subsequent hernia; but the facility of placing the ligature is not so great, and the vessel cannot be reached to as great a height as in the former method. This is particularly the case in Bogros' modification. These inconveniences however are easily obviated by prolonging the external angle of the incision obliquely upwards. Whatever method may be adopted, the importance of respecting the epigastric artery should not be lost sight of, as some of the cases of this operation have proved fatal solely in consequence of hæmorrhage from a wound of this vessel. Dupuytren lost a patient upon whom he operated in 1821 in this way. In placing the ligature, the epigastric artery should be left below it. Beclard lost a patient from neglecting this point: the epigastric artery came off above the ligature, and the formation of a sufficient coagulum having been thus prevented, a fatal hæmorrhage occurred on the separation of the ligature.

English surgeons allow an inch at least to intervene between the ligature and any collateral branch, either above or below it, which from its size might convey blood into the tumour, and thus keep up its pulsations or prevent the formation of a coagulum. The dangers of a different practice are now too well understood, for any intelligent practitioner to incur them unnecessarily.

The method of operating may however be less a matter of choice than of necessity, as the size, state, and situation of the tumour may determine.

In regard to the obliteration of the iliac artery, certain facts were known at an early period of the last century, which might have pointed to the probability of a successful result from the application of a ligature upon that vessel. Guattani's and Scarpa's injections had clearly established, that although a ligature had been previously placed on the external iliac artery, the coloured fluid passed freely into the arteries of the thigh and leg. In Guattani's case, already mentioned, in which he cured an inguinal aneurism by compression, both the femoral and iliac arteries were obliterated. This case dates as far back as 1767. In a case of Gavina's, which he operated on in 1755, on examining after death, the iliac artery was found completely impermeable. Baillie observed another case in which the obliteration of the femoral artery was continued up into the pelvis, while the limb was nourished as usual. Clarke observed a similar case in 1784. Notwithstanding the obvious tendency of these and other similar indications, it was only the danger of immediate death to his patient that compelled Abernethy to overlook the remoter dangers of mortification of the limb, or consecutive hæmorrhage, when he first performed this bold operation in 1796. He was unsuccessful in his two first cases, but in his third case, he was completely successful. Abernethy was followed by Freer of Birmingham in the same year 1806, and Tomlinson of the same town in 1807. The latter had a second successful case in 1809. From this period, the practice spread rapidly. In the next year, the external iliac was tied for the first time in France by Delaporte of Brest, and this case in all likelihood would have been successful, had the ligature been had recourse to at an earlier period. The ravages produced by the tumour itself, were so extensive, that the inflammation which followed in the diseased mass, proved fatal. Goodlad had a successful case in 1811, and Dorsey of Philadelphia, another in the same year. In 1812, Bouchet of Lyons operated with success on a patient, who died of an aneurism in the opposite limb, in the following year. In the same year, Albert's patient died of tetanus, on the 20th day after the operation. Mr. Norman and Mr. Brodie had each a successful case in 1813, and Mr. Lawrence one in 1814. Mr. Samuel Cooper states, out of 25 cases, that he only knew of three in which the limb was attacked with gangrene; and these three were the patients of Sir A. Cooper, Bouchet of Lyons, and Mr. Collier.

The operation of tying the external iliac is now as fully accredited in surgery as that of any other artery. It has been attended with a fair average of success in comparison with other operations of a similar kind. Indeed Mr. Wilmot remarks that as compared with the ligature of the artery in the thigh, the ligature of the external iliac artery presents more recoveries in proportion to the number of times it has been performed. Up to the present time, it is estimated to have been successfully employed in about forty cases, some of which have been attended with circumstances more or less worthy of remark. The case of Mr. Kirby of Dublin was followed by hernia which made its appearance through the line of the incision of the abdominal muscles. In Dr. Post's case, the peritoneum was so thickened and diseased, that he could not raise it from the subjacent parts, and was obliged to make an opening in it. The protruding viscera were then pushed back, and with a needle the ligature was introduced under the artery, the peritoneum being also included in the ligature. The patient nevertheless did well. In Mr. Newbiggin's case, there was inguinal and popliteal aneurism of the same limb, and both were cured by the ligature of the external iliac. Both the external iliacs were tied by Mr. Tait, the first on the 8th of May 1825, the second on the 16th of April 1826, and with perfect success, notwithstanding that the peritoneum was opened on one side. Arendt was much more bold; for he tied both the iliacs in succession, with an interval of eight days only between the operations, and was also successful.

The aneurisms of the external iliac artery are almost always spontaneous. Velpeau however relates a case of traumatic aneurism or rather of a wound of this vessel, in which by temporary compression time was obtained for placing the ligature. The patient was a robust young man, 17 years of age, who while cleaning a table in a dark place had inadvertently stabbed himself in the groin with a ham-shop knife, opening the iliac artery transversely about a quarter of an inch above the epigastric. The blood gushed out in torrents. Drs. Layraud and Durand, who were on the spot almost immediately, compressed the artery, two inches above the wound, and thus stopped the hæmorrhage while a messenger was dispatched for M. Velpeau. On his arrival, he at once laid bare the vessel and tied it. The ligature was not discharged till the 35th day, and the patient recovered perfectly. This interesting case illustrates two points: 1st, that a previous dilatation of the vessels, which are to carry on the circulation after the ligature of the main trunk, is not indispensably necessary to protect the limb from liability to gangrene, and 2d, that compression may be successfully kept up on a vessel of this magnitude, until efficacious succour may be obtained.

Compression, conjointly with general treatment, has in a few instances been successfully employed in inguinal aneurism. In Guattani's case, the pressure was made upon the artery itself, which he had previously laid bare, where it passes over the branch of the pubis.

Ligature of the Epigastric Artery:—If this vessel were wounded in the operation for exposing the external iliac, it would be the surgeon's duty to secure it, before he proceeded further. But it may also be wounded under other circumstances. Bogros gives the following rule for cutting down upon it. An incision two inches long, is made just above and parallel with Poupart's ligament, and about equidistant from the spine of the ilium, and symphysis of the pubis. As soon as the aponeurosis of the external oblique is exposed, a director is passed under its inferior edge, and it is divided in the same direction as the external wound. On raising the spermatic cord, the orifice of the internal ring is seen; this is dilated with the finger, and the artery is found behind its internal edge and sheltered by the fascia which forms that edge. The ligature is easily applied; but it should be placed close upon the wound, in order to leave space for the coagulum between it and the main trunk.

Fig. 95.

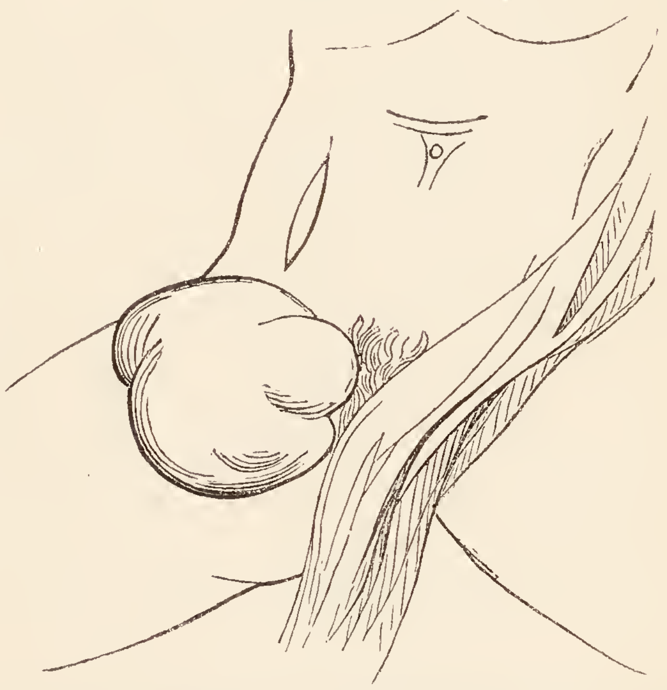

Fig. 95. *Aneurism of the external iliac artery, forming an enormous tumour in the groin.*

INTERNAL ILIAC ARTERY.

The course of this vessel is nearly perpendicular from the point where it is detached from the primitive iliac, in front of the sacro-iliac symphysis, down to the sacro-ischiatic notch. It is accompanied by the internal iliac, or hypogastric vein. The ureter passes obliquely in front of its origin.

Spontaneous aneurism of the internal iliac is so rare, that only one case of it is recorded. This case was observed by Sandifort. But its branches, the external ones more especially, are exposed to injuries from wounds which require the interference of the surgeon; and there are several instances on record of patients dying of hæmorrhage from traumatic or spontaneous aneurisms of the gluteal artery, from the want of timely succour.

Ligature of the internal Iliac Artery:—My friend Dr. Stevens of Santa Cruz, was the first to place a ligature on this vessel, in 1812, for an aneurismal tumour situated in the buttock, and which in the space of nine months, had attained to a very considerable size. The patient was a female slave. Having previously satisfied himself of the practicability of the operation, by a trial on the dead body, Dr. Stevens made an incision about five inches in length in the lower lateral part of the abdomen, parallel with and half an inch on the outer side of the epigastric artery. The skin, fascia, and abdominal muscles having been successively divided, and the peritoneum separated from its loose connexion with the iliacus and psoas muscles, as high as the division of the common iliac artery, he felt for the internal iliac, and insinuating his fore-finger between it and the vein, pressed it between his finger and thumb. The pulsation in the aneurism ceased at once, and the tumour began to diminish. The ligature was then passed round the artery, and tied about half an inch from its origin. The tumour disappeared almost immediately after the operation, and the wound healed kindly. The ligature came away three weeks after. The loss of blood during the operation did not amount to an ounce. This woman lived nearly twenty years after; at her death, a preparation of the parts was made, which is now deposited in the Museum of the College of Surgeons of London.

In the year 1817, Mr. Atkinson of York tied the internal iliac for an aneurism of the gluteal artery. The patient was a young muscular bargeman. The tumour was situated under the gluteus muscle, and had been coming on for nine months, in consequence of his being struck with a stone. Mr. Atkinson performed the operation in the same manner as Dr. Stevens; but the artery was in this instance situated at a greater depth, as it required the full length of his fingers to reach it. The pulsation of the tumour was arrested immediately on pressing the artery between the ligature and the fore-finger. This point once ascertained, it was unnecessary to repeat it for the satisfaction of the assistants and pupils; and had the vessel been less disturbed for this purpose, perhaps the operation would have been attended with a different result. The patient sank, partly from hæmorrhage, and partly from exhaustion, three weeks afterwards. The ligature was completely detached though it still remained in the wound.

Averill, in his Operative Surgery, also mentions a case in which the internal iliac was tied by a Russian army-surgeon, and on whom the Emperor Alexander settled a pension as a reward for the skill he displayed in the treatment of the case.

An American surgeon, Mr. Pommeray White, has also tied this vessel for a gluteal aneurism. His incision extended in the shape of a half moon, to the length of seven inches, beginning near the umbilicus, and terminating near the inguinal ring. He tied the artery about an inch from its origin, and united the wound with points of suture and adhesive straps. The case was successful.

The operation might also be performed by prolonging the incision made for placing the ligature on the external iliac.

Ligature of the Gluteal Artery:—The gluteal artery, which may be regarded as the external continuation of the main trunk, owing to its exposed situation, is liable to be wounded. Dr. Jeffray of Glasgow was consulted in a case of this kind: he recommended the wound to be dilated, and the vessel secured where it had been injured. His advice was not adopted till too late, for while the preparation was being made for the operation, the tumour burst, and the patient died of hæmorrhage.

In a similar case, John Bell dilated the wound, and tied the artery with complete success; and Mr. Rogers has published a case in which he was also successful.

The dilatation should be made with caution: Theden mentions a case, where in dilating a gun-shot wound, the gluteal artery was wounded by the surgeon, and the patient lost his life.

Mr. Lizars proposes the following plan for cutting down on this vessel:

The patient is made to lie on his belly, the thigh is extended, and the toes turned inwards. An ideal line is drawn from the superior posterior spine of the ilium to the middle of the space between the tuberosity of the ischium and the great trochanter. The artery emerges from the pelvis at the point where the two superior thirds join the inferior third of this line; here it lies in the space between the gluteus medius and the gluteus maximus. The incision, however, should not be made in this line, as it would divide the fibres of the gluteus maximus transversely; it should be made in the direction of those fibres, and in a line nearly corresponding with that of the sacrum and great trochanter, and passing over the point of emersion from the pelvis already indicated. The integument, and fibres of the gluteus maximus having been divided, and the muscle raised, the artery will be found immediately below the upper border of the great ischiatic notch. The length of the incision must vary according to the corpulency of the patient.

Mr. Brooke states that he succeeded by compression, and the exhibition of digitalis and laxatives, in dispersing a tumour which he believed to be an aneurism of the gluteal artery.

PRIMITIVE, OR COMMON ILIAC ARTERY.

In this, as in the case of other large arterial trunks, instances of spontaneous obliteration had been observed before any one had the hardihood to propose placing a ligature upon it. Dr. Goodison of Wicklow, while dissecting at the Pitié in 1818, found a long-standing and complete obliteration of both the common iliacs, without any apparent injury to the lower extremities. Sir A. Cooper's experiments on dogs had already demonstrated that the common iliacs might be tied in these animals, without producing gangrene of the corresponding extremities.

Valentine Mott of New York was, however, the first who tied the common iliac with success in 1827. The aneurism for which he operated, had been formed suddenly, and had in the short space of ten days attained to a considerable size, producing dreadful pain, and uplifting the walls of the abdomen at every pulsation. The tumour comprehended the whole of the external iliac, and even ascended a little above the origin of the internal iliac.

Fig. 96.

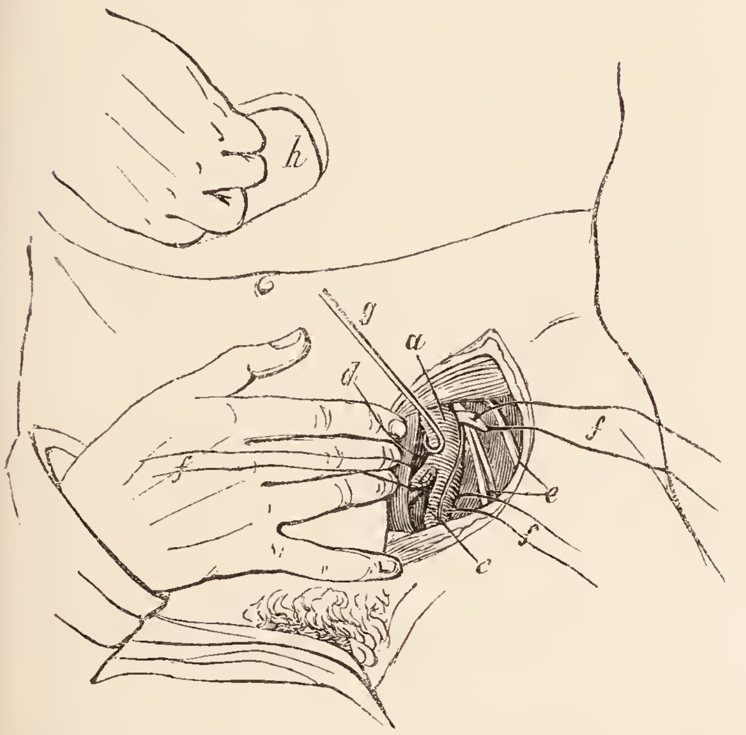

Fig. 96 *represents the incision of the abdominal walls; the internal border of the wound is retracted by the assistant's right hand, which supports the intestines at the same time, while his left hand holds a square pad, h, on the track of the aorta, ready to command the circulation, by compressing the artery against the lumbar vertebræ. The peritoneum, d, detached from the iliac fossa, and exposing the lumbar nerves which cross that space, is seen drawn across the upper part of the wound, and pressed also beneath the fingers of the assistant. In the centre of the wound, a, the great arterial trunk itself is seen bifurcating into the internal and external iliacs; the trunk or common iliac is raised on an aneurism needle, g, and ligatures, f f f, are placed on each division of the arterial tree. The external iliac vein, c, lies to the inside of the artery, and is crossed by the internal iliac artery. The satellite nerve is seen running down the surface of the main trunk, and should not be included in the ligature.*

Ligature of the Common Iliac.—Dr. Mott made a semicircular incision, which extended from the outer side of the inguinal ring, about half an inch above Poupart's ligament, to two inches above the spine of the ilium. The peritoneum was raised from the aneurismal tumour, and a ligature was placed on the artery a little way below the bifurcation of the aorta. The pulsations ceased immediately in the tumour, and the limb became cold; the natural heat returned about an hour after, and the patient recovered perfectly without showing any symptom either of hæmorrhage or gangrene.

In the following year, Mr. Crampton of Dublin tied the common iliac, and in all probability would have also saved his patient, had he employed the ordinary silk ligature. The patient died of hæmorrhage on the fourth day. It would appear from the autopsy, that the ligature of animal matter, which Mr. Crampton thought deserving of a preference on this occasion, had either slipped from the artery or been dissolved before it had become obliterated. The circulation, heat, and sensibility of the limb, were however, as in Mr. Mott's case, fully re-established long before this unfortunate event.

Dr. Gibson of Baltimore also tied the common iliac, but without success, for a wound of this vessel.

If the progress of an aneurism were slow, Valsalva's treatment ought however to be first had recourse to, and in some instances, perhaps Brasdor's method might find its application.

ABDOMINAL AORTA.

The aorta, after passing the diaphragm, gives off a considerable number of very important branches; but, at its lowest part, after giving origin to the inferior mesenteric branch, it runs to its bifurcation in front of the lower part of the fourth lumbar vertebra, a space of about two inches, without detaching any other branch. This portion of the aorta has been tied; and although the propriety of carrying out the principles of surgery, may in regard to this operation be questioned, either generally or in relation to a given case, still the possibility of the circulation being carried on, and the lower extremities being duly nourished after a ligature has been placed on the aorta, cannot be, for a moment doubted. The body is indeed a vast net-work of vessels, with communications almost innumerable between one set or division of these vessels and another, and the blood therefore, when interrupted in the main channel, instead of being dammed up and arrested, is forced through the collateral vessels until it reaches the main trunk again at some point below the obstruction; the route it has taken being, it is true, more circuitous, but not the less certain. The supply of a sufficient quantity of blood to nourish the lower limbs is regarded almost as a matter of certainty, in experimenting on dogs, when a ligature is placed on the abdominal aorta. Sir A. Cooper has fully established this fact, as he has frequently tied the aorta in dogs, and always found that the blood was readily carried by the anastomoses into the posterior extremities.

This operative proceeding however, it must be admitted, must almost always be had recourse to, under great disadvantages, so that any analogy between it, and the ligature experimentally applied on animals, cannot well be established. The nearest approach to such an analogy would be found in a wound of the vessel; yet if the wound were large, there would not be time to give the patient this chance for his life, and on the other hand, if the wound were small, the hæmorrhage might proceed so gradually, that the diagnosis of the wound of the aorta could scarcely be established with such a degree of certainty, as to justify the surgeon in undertaking so bold an operation.

In a case of spontaneous aneurism, such as that in which Sir A. Cooper operated, the chances of success are again materially diminished by the progress which the disease must have made, before the surgeon would think of proposing so bold a step, and the extensive obliteration which a wide spread tumour may have produced amongst the collateral vessels.

Nevertheless we by no means intend to say, that the ligature under no circumstances should be placed on the aorta. The subjoined case, while it calls forth our admiration of the moral courage of the man, will present to the minds of most people, as it certainly does to our own, a strong justification of the measures, which Sir A. Cooper resorted to, as the last resource to save the life of a fellow-creature.

A porter, aged 38, was admitted into Guy's Hospital, April 9, 1817, for an aneurism in the left groin, situated partly above, and partly below Poupart's ligament. The swelling was considerably diffused, and pressure upon it was productive of great pain. On the third day after his admission, the tumour was double its former size, and the pulsation had become less distinct. The blood could be felt within the sac, which was so large, that no operation was practicable without opening the peritoneum. Sir A. therefore waited in order to give the man the chance of a spontaneous cure. Notwithstanding venesection and compression were employed, the tumour continued to increase, and on the 20th June, a bleeding took place from a point of it, upon which a slough had formed. The bleeding was renewed at intervals, and on the 25th he was so much exhausted from loss of blood, that his fæces were voided involuntarily, and his immediate death was only prevented by keeping pressure upon the aperture. At nine o'clock in the evening, Sir A. made a small incision into the sac above Poupart's ligament, and introducing his finger, tried if it were practicable to pass a ligature round the external iliac artery within the cavity; but this was found to be impossible, as instead of the vessel, " only a chaos of broken coagula" could be perceived. At the moment of withdrawing the finger, two students compressed the aorta against the spine, and the incision was then closed with a dossil of lint. He now determined to apply a ligature on the aorta itself, and made an incision three inches long into the linea alba, giving a slight curve to avoid the umbilicus, which was just opposite the centre of the incision. A small aperture was next made into the peritoneum, and introducing his finger into the abdomen, he enlarged with a probe-pointed bistoury, the opening of the peritoneum to nearly the same extent as the external wound. Neither the omentum nor the intestines protruded, and during the progress of the operation, only one small convolution projected beyond the wound. An opening was scratched with his finger-nail in the peritoneum covering the aorta, and on the left side of the vessel, passing the finger between the aorta and the spine till it came through the peritoneum on the right side. The needle was then passed under the aorta, and the ligature tied, care being taken at the same time to keep the noose clear of the intestines. The wound was closed with the quilled suture, and adhesive straps. The pulse during the operation and for an hour after was 144. The sensibility of the right side was greatly impaired. In the night he complained of pain in the abdomen, but there was no tenderness on pressure. At first the lower extremities were cold, but the natural heat soon returned; the sensibility still, however, continued imperfect, more especially on the left side, where it was almost null. At eight o'clock next morning, the right limb had nearly recovered its natural warmth; and at noon, its temperature was 94°, while that of the left, the aneurismal side, was only 87½°. He complained of pain in the loins, and his urine and fæces were discharged involuntarily. His pulse fell, he vomited, and had cold perspiration. He died between one and two o'clock on the second day, the aneurismal limb having previously assumed a livid appearance, particularly around the aneurism, and its temperature having gradually declined again: that of the right, however, remained natural.

On examining after death, there was not the slightest appearance of peritoneal inflammation, except just at the edges of the wound: the omentum and intestines still retaining their natural colour. The ligature remained firmly placed about three-fourths of an inch above the bifurcation of the aorta. The superior clot was more than an inch long; that filling the vessel below the ligature, extended an inch down the common iliac on the right side; and the third clot on the left side, extended from the ligature to the aneurism.

The patient died, not from peritoneal inflammation, but from the want of circulation in the aneurismal limb; a sufficient circulation was re-established in the sound limb, and it may be fairly presumed that the same would have been the case of the other limb, had not the vital powers, that of the heart especially, been weakened by loss of blood, and had not many of the collateral channels, upon which a due supply depended, been obliterated by the extension and pressure of the aneurismal tumour.

One end of the ligature was left hanging out of the wound. Sir A. Cooper has since stated in his lectures, that if he ever should have to perform the operation again, he should tie the aorta from the side, and behind the peritoneum, the cavity of which he would not open.

Mr. James of Exeter performed the operation of placing a ligature on the aorta on the

5th July 1829, after having previously on the 2d June, attempted to effect the obliteration of the external iliac artery, by placing a ligature on the capillary side of the tumour. The patient survived the operation but a few hours. On examining after death, the iliac artery was found to be divided into two trunks, so that Brasdor's plan was not followed as Mr. James had imagined; it had, however, produced a temporary diminution in the force of the pulsations; and had this anomalous distribution been suspected, a second ligature might perhaps have led to a different result.

The aorta at various points of its course has been found obliterated. M. A. Severin speaks of a person in whom he found the aorta completely plugged up by a solid concretion, just below the emulgent arteries. Dr. Graham of Glasgow published in Med.-Chir. Transactions, an account of a case in which the aorta was found completely obstructed just below the canalis arteriosus. Dr. Monro mentions an instance in which the aorta was obliterated by the remains of an old aneurism, just above the common iliacs. In the case already mentioned, as having been observed by Dr. Goodisson, the obliteration had extended from the aorta to the iliacs. Other examples of this obliteration have been observed by Mr. Crampton, Sir A. Cooper, Larrey, Mr. Key, &c. These obliterations having occurred without affecting the nourishment of the lower extremities, furnish an additional proof of the power of the anastomoses to supply a sufficient circulation in place of that which had been obstructed. The spontaneous cure of aneurism of the abdominal aorta may therefore be accomplished, and should in all cases of this nature, be attempted by internal means, such as the exhibition of antimony, digitalis, low diet, general bleeding, &c., as well as by external applications, such as cold, sanguisuction, compression, rest, &c.

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(*Wm. B. Costello.*)

ANEURISM BY ANASTOMOSIS.

(See Nævus, Nævi Materni.)

ANGEIOLEUCITIS, from ἀγγεῖον, *a vessel*, and λευκὸς, *white; inflammation des tissus blancs*, Fr.; *inflammation of the lymphatics.* The domain of medicine and surgery has, within the last half century, been greatly enlarged by the successful study of the inflammation of arteries and veins. In this respect, however, the knowledge derived from the investigation of the venous, has been far more important than from that of the arterial system. Destined to bring back to the heart the blood that had been sent out by the arteries, and which had become altered in its properties, and at the same time, to offer a receptacle for all recrementitial matter, and for most of the molecules that are to make their way into the circulating torrent, the veins also serve as conductors to innumerable causes of disease, whilst they may be themselves the seat of various alterations. We find accordingly, at the present day, that the veins have acquired immense importance in general pathology.

But there is another system in the economy which seems to share with the veins the unfortunate privilege of concurring in the production of a variety of disorders, and which has escaped notice hitherto; to wit, the lymphatic system. In this point of view, it may indeed be affirmed, that it has been left in the same oblivion as was the circulatory system of the black blood, before it was made the subject of investigation by J. Hunter, and the modern physiologists. Adopting, to a great extent, the ideas of Mascagni, as to its physiology, I long since devoted my attention to the study of its alterations.

I felt satisfied, as the lymphatic vessels exist throughout the entire body, and as, like the veins, they serve for the convergent circulation, that, like them also, they might transport from one place to another the germ of many diseases, and by the disturbance of their own functions, give rise to changes in the tissues adjacent to them. What was already known as regards scrofula, and infiltration, and the opinions of M. Alard on elephantiasis, gave countenance to this idea; but it was necessary to examine the question under a different aspect, by taking as a guide for observation the assistance to be obtained from anatomy and physiology. My attention has been devoted to this subject since 1818; and the various papers which I published at subsequent periods, on the alterations of the fluids, are almost as strictly related to it as to the pathology of the veins; the only difference being this—that I had not, as I mean to do now, considered it separately, or in such a manner as to exclude collateral matter. The subject, however, even now, is too novel to admit of its being treated completely, and in all its details. I shall therefore confine myself to the points on which I think I shall be able to throw some light; and on that, more especially, which relates to the inflammation of the lymphatic vessels, known under the names of *Lymphangitis, Lymphitis,* &c., and which I prefer designating by the term at the head of this article.

The lymphatic tissue is capable of becoming inflamed in different ways, and in various degrees, like the other tissues of the body. Here, as elsewhere, we observe inflammations to arise from direct and indirect causes, from contusions, or from solutions of continuity, either of the lymphatic vessels, or of their ganglions themselves. But this inflammation, nevertheless, at its commencement, most commonly has its source in diseases quite foreign to the organs of which we are now speaking; and it will be readily recognised, that almost all the diseases of the lymphatic system arise in consequence of fluids, either produced or vitiated by inflammation, being introduced therein by absorption or imbibition, and carried from the periphery of the body to the centre. After establishing the etiology in accordance with this opinion, we shall examine the practical consequences to which it may lead us. I may here observe, that since the publication of my first memoir on this subject in 1836, the proofs of what I then stated have become so multiplied, that I can have no hesitation in giving the most positive character to the assertions and opinions advanced in this article.

If the inflammations affecting the canalicular portion of the lymphatic system have hitherto attracted so little attention, the reason is, that being, in the majority of cases, difficult to be recognized directly, they have been either mistaken for, or confounded with, the diseases of some other system—that of the veins for example. A rapid glance at their causes, mechanism, and situation will help to show the truth of this assertion in a clearer light.

Etiology.—Without absolutely admitting, with Mascagni, Fohmann, Faust, and Panizza, that the lymphatic vessels alone constitute almost the entire bulk of the cellular tissue and its components, we are compelled to acknowledge that these canals abound in the midst of the organic layers of the animal economy; nor does any one now deny their faculty of absorption.

The inference from this simple remark is, that lymphatic vessels surround and pass through every seat of disease, and that wherever disease exists, they may become charged with heterogeneous materials calculated to inflame them. This notion which, *à priori*, is in accordance with the doctrines of anatomy and physiology, is confirmed by daily observation at the bed-side of the sick.

Even in this respect the inflammation of the lymphatic vessels presents two very distinct varieties. In the one, the seat of the morbid action, or the altered fluids that give rise to it, are protected from the contact of the air; in the other, on the contrary, they are exposed to its action, either primitively or consecutively. Hence an essential difference, which it will be important not to lose sight of.

When there is no wound, ulcer, incrustation, or excoriation on the integuments, the altered molecules, modified by inflammation, or by any other morbid action, but rarely acquire properties as deleterious as those which in general characterize them, when deposited in deep wounds or solutions of continuity; and hence the possibility of their penetrating to some extent into the veins, without exciting inflammation, or producing any manifest disturbance. The same thing is clearly observed to occur, in regard to the lymphatic vessels, which, if it were otherwise, would be affected in almost every case. It may be added that, as in the case we are supposing, they are not contused, ulcerated, or cut, but protected, as it were, by the inflammatory action that is taking place in the other tissues, these canals are but little disposed to allow the surrounding fluids to penetrate them.

In opposite circumstances, the contrary obtains; and to be convinced of the fact, we have only to bear in mind, how rapid and numerous are the changes which take place on the surfaces of wounds in all the products of inflammation, in all the substances either taken into or ejected from the body; and that by reacting on each other, under the influence of the air, their elements are transformed, sometimes into new products, comparable in certain cases to real poisons. In becoming fluid, these substances are more in contact with the pores or extremities of divided vessels, and are thus rendered in general more acrid and penetrating. It seems but natural, therefore, that they should obtain an easier access to the torrent of the circulation, and that they should irritate the vessels more highly than in the preceding hypothesis. We may, however, imagine angeioleucitis to take place without any external breach of continuity, and by a mechanism similar to that of traumatic suppuration; all I mean to state is, that under such circumstances, *cæteris paribus*, it is of much rarer occurrence.

Angeioleucitis may be developed in three different ways: 1. *By continuity of tissue*, or from the external to the internal surface of the canal. In this case the lymphatic vessels that pass through inflamed organs at length become themselves inflamed at the point corresponding to those organs before they exhibit any trace of disease elsewhere. 2. *By obstruction*, or disturbance of their circulation. In this case they are so compressed in the midst of the diseased tissues, that they become inflamed below this point, in consequence of the distension resulting from the stoppage of their circulation; and 3. *By absorption*, or from within outwards. That is, when either, through their lateral pores, or their roots, they take up, in the affected parts, irritating principles in sufficient quantity to determine an inflammation, in the same manner as it occurs in the veins, or when the mischief has its source in a collection seated in the integuments.

In this last case, the inflammation of the lymphatics may also exist in three ways. 1. *By continuity*, or as it takes place in membranous organs; in which case, the inflammation, proceeding from the wound, attacks the lymphatic vessels, and seems to be rapidly carried towards their origin or termination, without their becoming of necessity on that account previously charged with the morbific products. 2. *By internal irritation*, or by *infection*: that is to say, that those of their mouths or roots, that are enveloped in the diseased locality, becoming charged with heterogeneous molecules, are rendered incapable of bearing the contact of such substances with impunity, and become inflamed secondarily, from the internal to the external surface in one or more points of this course. This is unquestionably the mode in which angeioleucitis is produced in the majority of cases; but we must admit also, that it may proceed from the external to the internal surface, or 3. By *contiguity of tissue*, as in the case where the skin is perfectly entire and healthy.

We have said enough to show how numerous and how various the causes must be that produce inflammation of the lymphatic vessels.

In taking the first species mentioned, viz. that which arises without any external solution of continuity, it will be perceived that inflammation in general, whether acute or chronic, whether diffused or circumscribed, is an incessant cause of it, so long as it exists in parenchyma, in the glands, under the skin, between the muscles, around the bones, in the joints—in a word, wherever the cellular tissue is found. It is the same with regard to the pus, whether it be found in the state of infiltration, or collection, or in that of a phlegmonous, or congestive abscess. What is said of pus applies also to blood, and to all other effused fluids, that have undergone alteration in the situations in which they happen to be pent up. All forms of cancer, tubercles, and the greater number of degenerations of tissue and of morbid productions, fall under the same category.

The second species of angeioleucitis has its source in all kinds of solutions of continuity, which, either immediately or at a distance, communicate with the atmosphere. Thus, perhaps, there is no disease of the skin that may not, at one time or another, have produced it. The psoric, lichenoid, eczematic, and variolic affections, ulcers, chilblains, scratches, wounds of all kinds, patches, or syphilitic tubercles, scirrhous, and encephaloid masses, and all forms of ulceration often give rise to it. Fistules, open abscesses, fractures, luxations accompanied with laceration of the integuments, and suppuration, the wounds resulting from amputations, or from any other operation, are equally capable of producing it. If we pass from the skin and the subjacent tissues to the mucous membranes, we shall only have to repeat these remarks, viz.: that the inflammations, eruptions, ulcerations, or lesions of whatever kind, of these tunics, that produce a morbid change in the fluids they imbibe, or with which they may be in contact, very frequently determine angeioleucitis.

After this enumeration, we cannot help being struck with the proportionate rarity of inflammation of the lymphatic vessels; but our wonder soon ceases, when we reflect that all these various causes are in general merely predisposing, and that conditions of another kind are still required in almost all cases to convert them into occasional causes. All these causes, however, of whatever kind they be, seem to act with greater energy at puberty, and in old age, than in the adult or middle period of life; when the cellular tissue and the white fluids are predominant, than when the constitution is dry and nervous, or strongly muscular; when the constitution has been exhausted by intemperance, improper regimen, or protracted illness, than when the health is good, and the individual robust. But, besides, the altered molecules must either penetrate in sufficient quantity, or be endowed with certain qualities to produce effect. In some cases, there may be absorption to a considerable extent, without producing any manifest bad consequences, whilst, in many others, a few molecules will be sufficient to determine the most intense and extensive inflammation. This peculiarity helps to explain why angeioleucitis is so uncommon, when compared with the frequency of the causes capable of producing it, in the inflammations or other affections not exposed to the action of the air, whilst the slightest puncture or abrasion, the most simple ulceration of the integuments may quickly produce it. It will also be easily understood how certain relative positions of the orifices of the pores of the lymphatics, as regards deleterious principles, should favour in a particular manner their absorption; vivid moral impressions, a sudden disorder of the functions, in a word, any circumstance capable of subverting for a moment the vital or organic harmony, in parts beyond that which had been primitively attacked, are equally calculated to develop its defects. In some cases, it might be said, that the causes of angeioleucitis, watching as it were for the moment when the organism is engaged in a struggle against danger from another source, assail the venous or lymphatic systems with the unresisted force of chemical action.

When the development of a disease may be promoted or retarded by so many conditions, it cannot be matter of surprise, that its natural causes should be so frequently present without producing it.

We may also add, that the molecular movements which commonly bring on angeioleucitis are probably subject to many other influences, and that we cannot at present presume to assert that we are in possession of all the bearings of the problem that relates to this form of inflammation.

Symptoms.—The phenomena accompanying inflammation of the lymphatic vessels are twofold, viz.: local and general. The local symptoms themselves differ more or less, according as the inflammation is superficial or deep-seated; it will be proper therefore to examine them in succession under these different aspects.

When the disease arises in the subcutaneous lymphatic vessels, if we examine carefully, we shall find, *almost always*, the cause to be a solution of continuity, an inflammation, or suppuration of the skin. A change is observed to take place in the pre-existing lesion; the diseased surface seems sunken and more inflamed; swelling takes place, and pain is felt around the wound; the suppuration which was going on in it is suddenly dried up or altered in quality, or it may all at once become more extensive; an erythematous blush appears round those wounds or ulcers that had been dressed with deteriorated adhesive plaster or rancid applications, or which had been covered with incrustations; streaks, bands, or patches, varying in colour from a bright or rosy red to a wine or violet hue, soon appear at other points of the diseased region. These bands are tortuous, irregular, and cross each other in such a manner as to form small islets of sound skin, and follow the tracks of the lymphatic vessels. They do not show themselves first on the parts nearest to the wound; those first seen are even sometimes at some distance above it. Erysipelatous patches, similar in colour, soon show themselves over a certain extent of the affected region. At first, they appear disseminated over different points, but they gradually group together, and are confounded into a species of erysipelas. The parts surrounding the centre of the disease are, in general, the first affected; from these it spreads in the same manner as common inflammation; but most commonly it shows itself at other points, more or less, so as to appear as if the patient had been attacked by erysipelas at several places simultaneously, each of these points being united with the rest by red lines or streaks. An acrid burning pain is felt in the situations of these red patches, and it even sometimes precedes the appearance of these red streaks or bands; it is exasperated by the slightest touch, and has the same character as the pain accompanying erysipelas—it is not throbbing, stinging, or lancinating, but resembles more closely that which is felt in a part that has been sun-burnt; the swelling is slight at first, and scarcely perceptible between the inflammatory streaks, or even along their course. These bands themselves sometimes retain all their natural suppleness, and by no means communicate that feeling of induration which, from their appearance, one might be led to expect. The patches also may exist for some time without presenting this complication; the contrary, however, is most frequently observed, and the tumefaction of the subcutaneous layer follows quickly upon the development, of those inflammatory trains or patches. The diffusion of the swelling is but seldom complete; it extends very irregularly both in depth and surface, and is developed more perhaps by nuclei than by patches; the rarefaction that it produces seems moreover to be manifested more in the skin, cellular tissue, and the neighbouring layers, *en masse*, than to confine itself to any one of them in particular. It appears to attach itself much more closely to the canals, plexuses, and lymphatic ganglions, than to the anatomical arrangement of the cellular tissue, strictly so called. At first, the tissues retain a certain degree of suppleness, notwithstanding the swelling and redness. At a later period, the tension increases, and their feel is like that of sponge; to the finger they seem as if they were œdematous, and are in reality the seat of infiltration; the tension, however, has not a frank, elastic, equal, and regular character, nor is it the same as we find in the doughyness of the acute phlegmon, or phlegmonous erysipelas. What has been stated as regards the redness, swelling, and tension, will apply also to the heat, which is great only at the commencement, and which does not increase in proportion to the other symptoms. To render the description of superficial angeioleucitis complete, we have only to mention the swelling of the ganglions, into which the inflamed vessels pass as one of its most constant symptoms. It is difficult for the fluids circulating in a canal thus affected, not to deposit some germ of irritation in the ganglions through which they pass. It is, however, possible to conceive such a case, and I have myself seen several instances of it, either in consequence of obstruction below the seat of the disease, or from its being rapidly circumscribed, and the vessels becoming obliterated, so as quickly to transform it into an erysipelas or phlegmon.

When the attack occurs first in the deep-seated lymphatic vessels, as sometimes happens in the case of wounds or ulcers that pass under the fasciæ, as also of contusion, inflammation, abscess, or ulcer, the symptoms assume a somewhat different character. It is the pain that first attracts notice. It is fixed in a particular spot, where it may remain for a considerable time; it is deep-seated, sharp, or lancinating. If the mischief extends, the pain is soon felt in other regions, simultaneously or successively; and though it cannot be said to be positively absent in the intervals separating the points in which it is most acutely felt, still it does not excite sufficient uneasiness to be much complained of. The pain is not radiated in lines from a given point, nor is it diffused, neither does it remit; it is a fixed pain, though disseminated over particular spots, varying in the degrees of its intensity at different points. The tumefaction comes on afterwards, or it may occur almost at the same time, and in the same places as the pain. It proceeds, and is developed from the centre to the circumference. It is observed under the form of masses of more or less extent, of thick and long cores; but there is no appearance of patches, as in the case described already. Its origin is without difficulty recognized to be from beneath the fascia, and the tissues are less dense in proportion as they are nearer to the skin which retains for a long time suppleness and a certain degree of mobility. Should the swelling become general, the first characters will nevertheless persist to some extent to the end; in the midst of the general tumefaction we can discover, here and there, points more swollen and perceptibly more dense than others. The redness only becomes manifest subsequently to the two preceding phenomena. It is less superficial than in the former variety, and can be only seen as it were by transparency in the shape of irregular patches, and not as streaks or bands. It would seem to be more intense and more extensive according as the eye pursues it to a greater depth. The skin moreover being stretched, and as it were thinned, is shining, and more of a whitish or pale rose colour, than truly red, in the intervals of the inflamed points. Generally speaking, it is the deep lymphatic ganglions that first swell and become painful. The inflammation proceeds so rapidly, and to such an extent, that the deep-seated variety of angeioleucitis has, in many cases more the appearance of inflammatory œdema, than that of a diffused phlegmon or of a phlegmonous erysipelas.

It would, however, be wrong to imagine that the two plans of the lymphatics may be thus long affected independently of each other. More frequently, on the contrary, the affection of the superficial lymphatics is communicated to the deep-seated vessels, and *vice versâ*. Hence in the first variety the engorgement, infiltration, and pain, are often found to extend to the entire thickness of the parts, in the same manner as in the second; sooner or later, red streaks, and true erysipelatous patches are seen on the skin; and thus do the superficial and the deep-seated ganglions become almost invariably affected in both cases.

There is, however, no difficulty in explaining this progress of the inflammation of the lymphatics. The ganglions swell because vitiated materials are presented to them instead of the fluids which usually pass through them. The bands and red streaks only show that the inflammation has been transferred to the cellular envelope of each of the inflamed vessels; and it is only at the points where these vessels inosculate, or seem to form a net-work, that those patches of deeper red, and those kernels of greater hardness, can be discovered, because at these points, several inflamed lines may, at an early period, have been confounded, and extended from one to another, through the medium of the interposed cellular tissue. The tumefaction and engorgement, in this instance, as in every other inflammation, are attributable to the afflux and stagnation of the different fluids; but they are more considerable, and more frequently accompanied by infiltration, because the lymphatic vessels cannot be, for any considerable time, inflamed, without having their calibre diminished, the course of the lymph deranged, or without causing a portion of the white fluids to be extravasated into the surrounding tissues, and thus to stagnate, in consequence of being forced out of their natural channels. The disease passes from one plan of the lymphatic vessels to the other, in consequence of the numerous communications that exist between them, and because, by the disturbance of the functions of the one the disease almost necessarily reacts on the other. It may be also added, that angeioleucitis must frequently be followed by erysipelas or phlegmon in various shades, either on account of the stagnation of the fluids it produces in the surrounding tissues, thus giving rise to inflammation on the confines of the parts occupied by the disease, or because those fluids which it prevents from returning into the general circulation soon act as foreign bodies between the small canals that had been primitively affected.

General symptoms.—These not being subject to the same modifications as the local symptoms, it becomes unnecessary to make a distinction in this respect between the superficial and deep-seated angeioleucitis. Its invasion is often announced by mere horripilation; but more frequently it is ushered in, or preceded by, irregular rigors, or ague-fits, like those of vernal intermittent fever, or the trembling or agitation that indicates the extensive inflammation of a serous membrane. These rigors, or tremblings, alternate with great heat and dryness of the skin, the rosy hue of which rather increases, than diminishes, at least during the first days of the attack. The pulse, always frequent, is at one time strong and full, as in an inflammatory fever; at another, small and irregular, as in low fever. There is in general great thirst, and a feeling of anxiety about the præcordia; the patient suffers from nausea, and sometimes from vomiting. Complete delirium is seldom manifested at first, but watchfulness and agitation are almost always present, accompanied by manifest alteration in the functions of the nervous system; the mind seems absorbed in reveries; the ideas are confused. A part, or even the whole of these various symptoms may be present two or three days before the local symptoms become developed.

The accompanying fever has nearly the same character as that of an exanthematous inflammation; with this difference, however, that instead of disappearing, it becomes aggravated after the development of the angeioleucitis. The tongue is covered with a greyish or yellow fur; it is soft, and but slightly reddened at its point or edges; it does not become dry till a more advanced period, unless the disease be very intense. When this is the case, the point and centre are the first to become incrusted. In some cases, however, it assumes the appearance of a rasp throughout its entire surface. In being dried up, it does not always lose its greyish or red colour; the tissue of the tongue itself seems to be hardened, just as much as the slimy crust with which it may be covered. At a later period it is entirely covered with crusts, and is cracked in the same manner as in typhus fever. The gums and the rest of the mouth become fuliginous, and most commonly delirium supervenes. On the whole, angeioleucitis gives rise to a degree of general reaction, which resembles more closely an ataxic fever, than one of a purely adynamic character.

We can easily account for the disorders we have been describing by arranging the symptoms into two distinct groups: the one produced by inflammation,—the other, resulting from the infection of the blood. The development, fulness, and frequency of the pulse, the heat and high colour of the skin, and the thirst, belong to the first; the rigors, agitation, nausea, and the state of the mouth, to the second. When the inflammation runs high, and is extensive, the vascular reaction is at first very considerable. The ganglions, and the obliterated vessels impede, it is true, the admission of pus, or of an irritating principle into the blood, but do not absolutely prevent it in all cases. So long as the circulation in the lymphatics is carried on, it is almost impossible that some portion of the fluids vitiated by the angeioleucitis shall not find way into the veins; and I am only astonished that the fact could be disputed. It cannot, however, be denied, that this infection takes place very slowly, and, as it were, by molecules; and hence it is, that the symptoms which indicate it are, at first, in a manner lost, or confounded in the midst of the symptoms of inflammatory reaction; whilst, at a later period, they often become predominant.

Termination and prognostic.—The inflammation of the lymphatic vessels may terminate in resolution; but suppuration is one of its very common consequences; it also terminates often in death. Resolution may be confidently looked for when the inflammation extends to but a few vessels, and when it has not gone beyond the superficial plan. The same may be said of the cases in which the parts where the inflammation has become developed are of a nature to cause its prompt subsidence, or to admit of its being easily accessible to the resources of art. When the circumstances are different, suppuration is almost inevitable; it must be expected to supervene whenever the red patches are numerous, and have a tendency to run into each other, and when beneath them, painful cores of a certain thickness can be felt. The suppuration, however, takes place slowly, and is found in two different states, either in that of infiltration, or as a collection of variable extent. The pus remains infiltrated under the red streaks, along the vessels, and between the layers of muscles. The abscesses occur more particularly under the patches, and in such a manner that the principal inflamed nuclei form the centres of so many purulent collections. Sometimes, also, the abscess is large, and the matter is diffused as in the case of a phlegmonous erysipelas. But whether these abscesses be superficial or deep-seated, the fluctuation is not felt in them till an advanced period, and when opened, the quantity of pus which escapes is much more considerable than could have been expected from the apparent extent of the tumefaction. There is generally more than one, and the first collection is merely the precursor of several others, which occur in succession, at intervals of a few days, and at different points. I have in this way seen as many as twenty-five in the same individual. They are surrounded by a pasty, or hardened edge; but it does not remain so long as in the case of a common phlegmonous abscess. In the cavity, neither bands nor partitions can be detected, and although the pus contained is usually very fluent and thin, the secretion soon ceases, and the parts cicatrize rapidly.

The termination by induration without suppuration is rather uncommon, and occurs almost exclusively in chronic angeioleucitis. M. Alard's description of it is tolerably correct. Some cases of this form of the disease have been since published by physicians who have devoted their attention in a special manner to the diseases of the skin. It occurs after the acute form of the disease, only accidentally, as for instance when some constitutional taint, or an imperfect treatment may have disturbed the progress of the symptoms. In this case, the lymph which remains in the state of infiltration in the meshes of the cellular tissue is but slightly altered, and sufficiently concrescible to have a constant tendency to combine with the tissues which it has swollen, or hypertrophied, and which it transforms into lardaceous layers or masses.

Angeioleucitis may terminate in death, either at the time when the inflammatory reaction is at its height, or towards the end, when the suppuration is prolonged. It may be apprehended, in the first case, when high delirium, a dry mouth, and nausea accompany an extensive inflammation, which continues unabated till the eighth or tenth day. It may also be dreaded in the case where the inflammation is extensive, deep, and severe, more especially in an individual of broken constitution, or advanced age, and when the suppuration threatens from the first to be vast and abundant. At a later period, the fatal termination is brought on by the recurrence of the abscesses, through the exhaustion arising from the abundance of the purulent secretion, from the occurrence of fresh attacks of the disease in the viscera, or from effusion into the serous cavities, and vitiation of the blood, by its mixture with the pus, or absorbed substances. Rigors, with decomposition of the features, intermittent fever, diarrhœa, irregular sweats, meteorization of the abdomen, pain or uneasiness in the head or chest, are the usual preludes to it.

On the whole, the progress and duration of angeioleucitis are extremely variable; in some instances, it is developed so rapidly that on the eighth day there can be no longer a doubt as to the formation of pus; in others, the progress is so slow, that even on the twentieth day, there is no saying with certainty how it will terminate. In some individuals its phases are perfectly regular from beginning to end, whilst in others, all the groups of symptoms are graduated and distributed as if they belonged to several distinct and successive inflammations. When resolution takes place, it may be looked for from the fourth to the tenth day. The suppuration may be established as early as the eighth day, but most commonly it does not become manifest until the fifteenth or twentieth. It is also from the eighth to the twentieth day, that death is observed to take place. Beyond this period it seldom occurs till after the thirtieth or fortieth day, when induration may take place, and when internal collections, the contamination of the blood, and diarrhœa, are more especially to be feared.

These details, which I have taken from the attentive observation of a great number of cases, show clearly that angeioleucitis is a disease of sufficient gravity to excite the deepest solicitude on the part of the practitioner. The dangers to which it exposes vary, however, according to an infinity of circumstances, relative to the importance of the part affected, to its superficiality or depth, to the nature of the morbific principle which has produced the disease, and to the peculiar disposition of each patient. It must be obvious, all other conditions being alike, that the disease must be more serious when situated in the splanchnic cavities, than on the surface of the body; that it must be less dangerous when confined to the integuments, than when it extends through the entire thickness of a limb; the presence of a wound must also render it more formidable. When the disease is caused by the absorption of a septic principle, as for instance, in a dissecting wound, it is most dangerous. In other respects, the more serious the lesion from which it arises, the greater will be the danger; whenever it originates from a deep compound fracture, an articulation that has been opened, or a purulent cavity situated in the midst of tendons, &c., it always puts the life of the patient in more or less jeopardy; whilst the form of the disease which occurs in connexion with a solution of continuity of the integuments, or of the subcutaneous tissue is generally more disposed to terminate favourably. It may be observed, therefore, that the angeioleucitis that arises in the intestines in the course of typhus fever, in the bronchi from measles, in the uterus from metro-peritonitis is infinitely more formidable than that which takes place after the application of leeches, or the small wounds inflicted in cupping. In infancy, it is more prone to terminate in induration than in death. In the adult, its most common termination is in suppuration. In persons debilitated by illness, or of advanced age, the consequences most to be dreaded, and which render the disease so very serious, are low fever, gangrene, &c. We may also add, that its dangers depend, moreover, on the circumstances that may complicate the primitive affection, and that, in consequence, nothing can be more difficult, than to generalize the prognostic of angeioleucitis.

Differential diagnostic.—We may observe once more, if the inflammation of the lymphatic vessels has been so much overlooked hitherto, the reason is simply this: that some of its symptoms have a close resemblance to those of several other affections; such, for instance, as phlebitis, neuritis, or neuralgia, erysipelas, and phlegmon. However, as it differs in a great many respects from these lesions, a clear examination of its principal symptoms ought to enable us to avoid such mistakes. It is the more important to establish a differential diagnostic, as, in regard to the prognostic and treatment, there can be scarcely any analogy established between it, and the other forms of inflammation that so closely resemble it; and, as it can only be by proceeding in this manner, that the confusion which still prevails in the therapeutics of the inflammations of an acute character, can be dispelled. In this point of view, therefore, it is of especial importance to contrast it with phlebitis and erysipelas.

Phlebitis, it is true, is produced by the same causes, and under the same influences as angeioleucitis, but its progress and anatomical characters are far from being in every respect similar. It is most commonly ushered in by purely local symptoms, instead of commencing by a movement of general reaction. The red bands which indicate it are larger, fewer, less frequently crossed, more deeply seated, and correspond to so many hard, round, moveable cords, which are painful, and sometimes as thick as the finger. The red patches, when any exist, rest on nuclei that are more clearly defined, less deep, and less adherent; and they seldom become united in such a manner as to constitute a tolerably regular erysipelas. The suppuration occurs more rapidly, and the abscesses thus formed are either diffused, as in phlegmonous erysipelas, or less full of matter than might be supposed before they were opened. The pus evacuated from them in the latter case is often reddish, and seems as if it were mixed with decomposed blood. They are sometimes very numerous, but smaller; and they are almost always developed along the tracks of the large venous trunks, but not dispersed indifferently throughout the different regions of a limb. The tumefaction is, in general, less, and does not extend to the entire thickness, or to the whole circumference of the part, unless the phlebitis be deep-seated, and in that case, the redness of the skin, and the subcutaneous abscesses have no resemblance whatever to those produced by angeioleucitis. The skin is neither tense nor shining; it seems rather thickened, or simply inflamed. If infiltration be added to the inflammatory engorgement, it remains, almost constantly, below that degree of it which might cause it to be mistaken for œdema; it seems to be rather under the skin, and to possess that character of doughyness which indicates in the diffused phlegmon the presence of pus. As soon as they are opened, the abscesses of phlebitis empty themselves, and resolution takes place rapidly without leaving any permanent traces of induration beneath them. *In general*, the lymphatic ganglions are neither swollen nor painful, and the pain, instead of being severe, is dull.

The general symptoms have less of the inflammatory than of the adynamic character, and do not begin to be manifested till the time when the pus, secreted and exhaled by the veins, commences to circulate with the blood. Their development is then rapid. The rigors and tremblings are longer and stronger, although more irregular; the pulse is smaller and more unequal; the tongue is more foul, and more frequently red, and then dark, before it becomes dry and incrusted. The agitation, anxiety, heat, and thirst are less; the delirium, and irregular sweats come on more quickly. An expression of stupor is soon observed in the countenance; there is diarrhœa or constipation; the skin, which is of a grey or leaden hue during the cold stage, often assumes a gradually deepening yellow in the intervals of the rigors and tremblings. The resolution is more easily accomplished either before or after the suppuration becomes established, so long as the symptoms of purulent infection are not manifested. On the other hand, death almost always ensues, when the general symptoms are developed. The patient dies, or is out of danger, except in the case where the progress of the inflammation is irregular, much sooner than in the angeioleucitis. Phlebitis, in a word, is formidable, more particularly from the kind of poisoning it causes, and by the facility it finds of extending itself towards the great vascular trunks; while angeioleucitis is infinitely more so, on account of the local disorders of a decidedly inflammatory nature that result from it. As a local inflammation, the former is very easy, the latter very difficult to check. As a general affection, the case will be exactly the reverse of this. Leeches, not general bleeding, will often arrest a partial phlebitis; compression, multiplied incisions, mercurial ointment, or flying blisters, will have the same effect. If suppuration takes place, and that the pus is not poured into the torrent of the circulation, the development of the general symptoms will be prevented by the opening of the abscesses; and though the disease may have been very extensive, it will be by no means serious. When the signs of infection exist, the local treatment is of no value whatever, and even the internal medication, whatever it may be, is of very doubtful efficacy.

We see then, that if some points of resemblance exist between angeioleucitis and phlebitis, the points of dissimilarity are still more numerous. After the parallel just drawn, it would be no longer pardonable to confound them one with the other, except in the case of which it is easy to conceive the possibility, and I have myself witnessed more than once where the one was added as a complication to the other. The inflammation of a large vein, it is obvious, may be transmitted from it to the numerous lymphatic ganglions which surround it. In this case, the ganglions will become engorged, unquestionably, as in angeioleucitis, and the infection of the blood will be effected as in phlebitis, but the very fact of these two classes of symptoms being observed to be present together, will be sufficient to apprise the practitioner that these two diseases are united. The same thing would take place, but in an inverse sense, if the inflammation was transmitted from the veins to the lymphatic vessels. The succession of the symptoms, or the order of their apparition, would moreover indicate which was the primitive affection, and which the complication. It must, however, be admitted that these two forms of inflammation exhibit a very close affinity in regard to their causes, their mode of production, and their deadliness. It would, therefore, be improper to attempt to isolate them by means of perfectly defined signs and limits. Their tendency to unite, both at the commencement, as well as through their intercourse, the symptoms that are common to both, and the difference as regards the dangers incident to them, are quite enough to challenge all the attention that the practitioner can bestow on the distinctive characters of these two diseases.

The symptoms of angeioleucitis could only have been mistaken for those of nevritis through inadvertence or the little attention bestowed upon it, as a distinct form of inflammation. Whether there be true nevritis, or mere neuralgia, the affection will be nevertheless manifested by pains, which are at once radiating, dull, and lancinating,—pains which are not always augmented by pressure, which are liable to frequent exacerbation, and which follow, from the trunk to the branches, the known course of one or more nervous cords; by the weakness or numbness of the part; by the absence of tumefaction, redness, streaks, erysipelatous patches, external suppuration, infiltration, and of all the other symptoms of phlebitis and angeioleucitis.

Erysipelas.— The mistake, though more likely to be made in regard to erysipelas and phlegmon than nevritis, is not so much so in regard to phlebitis. If we examine the question attentively, we shall be readily convinced that angeioleucitis is more frequently mistaken for erysipelas than for any other affection, and the reason is this,—that many surgeons continue to comprehend under the name of erysipelas many very different diseases, many forms of inflammation that are by no means identical. If a diffuse inflammation of the teguments were alone sufficient to constitute an erysipelas, there can be no doubt that angeioleucitis, and even phlebitis, might in many instances be thus designated. But it is quite obvious that this mode of considering the matter is inadmissible; else how can there be any agreement respecting the value of the therapeutic agents to be employed, or how can any opinion be formed as to the danger of the disease? We must conclude, therefore, that it is of the utmost importance to distinguish these two forms of inflammation from each other. Common erysipelas is neither preceded nor accompanied by red streaks, or tumefaction of the lymphatic ganglions. If the contrary should take place, it only so happens in consequence of the erysipelas being complicated with adenitis, or angeioleucitis, The inflammation in this case seems to proceed from the epiderm towards the deep-seated layers of the skin, and is not manifested in scattered patches. The subjacent swelling is equal, and simply subcutaneous, being neither deep-seated nor distributed in masses or cores. It extends by continuity of tissue, instead of bounding, as it were, from point to point, over different regions. The skin, and not the layer beneath it, is its primitive and specific seat. Its progress is much more rapid: the formidable symptoms, such as delirium, and dryness of the tongue, often appearing as early as the fourth or fifth day. It rarely terminates in suppuration or induration, and resolution takes place from the third to the eighth day. When death occurs, it can scarcely ever be attributed to the local mischief. Topical applications have little, if any influence in arresting its course; neither leeches, nor compression have any effect; and the same may be said of poultices, emollient fomentations, and mercurial inunction. Those who attribute great virtue to mercury are altogether in error, as the pure axunge alone is just as efficacious, and it can only have been through an imperfect observation of the facts, that the error could have obtained credit. All these applications, together with blisters, which, on the contrary, will be found useful at a certain stage of angeioleucitis, are in this form of inflammation quite useless. In erysipelas, the surface of the epiderm seems as if thickened, and presents small vesicles, and sometimes even phlyctenæ of a certain size. It has a yellowish rosy hue, terminating abruptly at the limits of the disease, by an elevated and festooned edge; half a line beyond which, the slightest alteration of colour in either the skin or epiderm cannot be discerned, and it would seem as if the inflammation was shed over the derm like a layer of milk or oil. We see nothing of this kind in angeioleucitis,—the redness of which is bright or pale, or inclined to violet; it has no defined limit, but disappears insensibly, in such a manner, that it would be impossible to fix the line that separates the disease from the unaffected tissues. The skin may be thickened and elevated, but in general it is not covered, either with vesicles or phlyctenes at the commencement; nor does it present a surface in relief, as if it had been overlaid with another layer.

If we now pass from simple erysipelas to the *phlegmonous erysipelas*, differences less strongly marked, it is true, but still sufficiently obvious, will be quickly discovered. At the outset, most commonly, the general symptoms are absent; the inflammation spreads gradually, leaving none of the parts unattacked through which it passes. It does not appear under the form of scattered patches, or indurated cores; neither is there any appearance of red or livid bands. The ganglions are not engorged, nor does it seem to be developed more along the trunks of the lymphatics, than elsewhere, although, like angeioleucitis, it appears to spread rather from the deep-seated tissues towards the surface, than from the epiderm towards the fasciæ. Suppuration takes place very rapidly, the collection being large and widely diffused, and the pus greyish and thin. The cellular tissue is extensively destroyed, and the integuments are so rapidly thinned as to be in danger of perishing also. If the inflammation has not attacked from the beginning a considerable extent of surface, the febrile reaction will be, in general, trifling before the pus is formed.

The general symptoms are not of a nature to excite any serious alarm, till after the second period. We then have symptoms of infection, but which tend rather to the adynamic than to the ataxic character. The skin becomes dull, soiled, and earthy; the tongue blackens, and the delirium is of a calmer kind. If the attack be recent, and still limited to a small space, general bleeding, and emollients, properly employed, will often bring on resolution. The application of cold water will also stop it during the first two or three days. Compression, properly made, is regarded as the grand remedy, so long as suppuration has not taken place. Mercurial inunction will not arrest its progress. When we cannot insist on compression, multiplied incisions stop it at once; as if by enchantment. Blisters do not abridge its duration, unless they be of enormous size, and are only calculated to assist in circumscribing certain purulent collections. We see, then, that phlegmonous erysipelas is a disease essentially distinct from angeioleucitis. It must, above all, be not forgotten, that the one often complicates the other; and it is for this reason that they have been, and are still, daily confounded in practice. A most remarkable instance of this occurred in my own wards, in the months of March, April, and May, 1837: almost all the patients that had been affected with angeioleucitis were soon after attacked with erysipelas, strictly so called, or with phlegmonous erysipelas; and, in like manner, those who were first attacked with erysipelas, soon presented it complicated with angeioleucitis. But these combinations by no means prevent our singling out the special characters and symptoms that belong to each of these diseases, and that distinguish them from the compound inflammation.

As to the common phlegmon, its aspect is so well defined, that if we only examine with a little attention we cannot be deceived. Its circumscribed form, its hardness at the very beginning, the throbbing pain, and heat, the elevation which it tends to present towards the skin, the simplicity and regularity of its progress, the absence of streaks, of scattered patches, of engorged and painful ganglions distinguish it so clearly from angeioleucitis that there is no room for mistake in this respect.

The *Erythema nodosum* is a disease, which, to a certain extent, might impose on the practitioner. In some cases, this affection, which is characterized by the sudden development of a variable, sometimes a considerable number of red or livid patches spread here and there over different parts of a limb, is preceded by fever for two or three days, and so far really does present some analogy to angeioleucitis. Happily, the dark hue of those patches, and their superficial position, the appearance of fluctuation which they present, and their sudden disappearance after a few days, without leaving any trace behind, in conjunction with the absence of general symptoms, and of engorgement of the ganglions after they have been once developed, will not leave us long in doubt as to their true nature. With one moment's reflection, indeed, the error would be scarcely possible.

Pathological Anatomy.—The alterations that follow inflammation of the lymphatic vessels, are of three kinds: the first is of the vessels themselves; the second takes place in the interposed tissues; the third must be sought for in the viscera, in the blood, and in the remote regions.

In consequence of their minuteness, the lymphatic vessels, even after they have been inflamed, are not always easy to be examined in the dead subject. When they can be successfully isolated their internal surface is found to be slightly tomentous, and rather of a milk-white than a rosy colour; on the outside, they are surrounded with cellular tissue, which is easily broken down, and more or less infiltrated with a turbid, half concrete lymph; their parietes are evidently thickened. I have several times ascertained that even under these circumstances, their permeability may be maintained. The points most diseased are those which correspond to their crossings, and those opposite to their valves; it is at these points that their envelope is often found infiltrated with true pus, that they are closed, that lardaceous cores are observed, the same as in the centre of an abortive phlegmon, and that we must look for the origin of some of those abscesses, that have been observed during the progress of the disease. The skin, which is sometimes covered with large phlyctenes, presents towards the end scattered eschars, or mortified patches. These patches are greyish, or of a yellow white; they are softened, puffed, and in a state of purulent decomposition, or rather of gangrene,—their aspect bearing some analogy to the soft tenacious centre of the furuncle or anthrax. Beneath the integuments, the cellular tissue is found to possess a healthy character in some places; in others, it is more or less indurated, and, as it were, lardaceous, infiltrated with pus or turbid serum, broken up by ulceration wherever purulent collections have taken place, and more or less thickened throughout. The fasciæ, muscles, and nervous cords are but little altered, the disorders being confined chiefly to the interstitial cellular tissue. Between the muscles, around the vessels, in a word, wherever this tissue exists, it is infiltrated, hardened, thickened, or destroyed, from space to space, in the same manner as we observe under the skin. When there is suppuration, the matter is found in circumscribed collections, rather than in sinuses, or canals; and, unless in a very rare case, no mortified tissue can be discovered beneath the fascia. The arteries and veins are sometimes thickened or increased in size: but in dissecting them, this appearance is found to depend on the thickening of their external layers, and on their vicinity to the larger lymphatic vessels.

If the disease has existed for any time, the blood is in general very fluent, abounding in serum of a reddish rather than a dark colour. The few coagula which are found in the nervous system are diffluent, and frequently mixed with yellow grains. When polypiform concretions are found in the arterial system they are also more pliable than those met within persons who die of diseases purely inflammatory; they are also less homogeneous, and they frequently present yellow, black, white, and red fasciculi. Pus, however, has not been found either in the ventricles or the great vascular trunks.

Abscesses are but very rarely discovered in the parenchymatous organs, and those which are found in the liver and lungs are more numerous than large. When angeioleucitis has had its source in a cancerous affection we find instead of them, concrete masses; seropurulent effusion in the pleura, in the peritoneum, in the articulations, partial inflammation of the viscera, with hepatization and infiltration of pus, are also frequently observed. The brain seldom exhibits any appearance of lesion; and in the stomach and intestines the traces of inflammation are extremely faint. The follicles and agglomerate patches of Peyer are neither enlarged nor ulcerated; and if any ulceration is perceptible, it is found rather in the neighbourhood of the large intestines and the rectum. On the whole, the internal lesions found after death are often very disproportionate to the symptoms observed during life. The same remark is not wholly inapplicable to the local lesions; for we often find that the traces of inflammation are slight where the angeioleucitis had appeared to be severe. The lesions found after death, when caused by phlegmonous erysipelas, are much more profound.

Treatment.—All the plans of treatment adopted in phlebitis, erysipelas, and diffused phlegmon have been resorted to in inflammation of the lymphatic vessels; in the first place, because these affections have been mistaken for each other; secondly, because as an inflammation it would seem to indicate the use of the usual antiphlogistic and debilitating remedies; and, finally, because as it frequently disappears spontaneously, thus offering an instance of an inflammation, the gravity of which presents innumerable shades, the practitioner is easily imposed upon on the score of the efficacy of the means employed. It has been treated, therefore, variously by abstractions of blood, emollients, blisters, multiplied incisions, mercurial, or ioduretted frictions, compression, purgatives, &c. Experience, however, has convinced me that these different resources may be all, either useful or insufficient; and that, in order to determine the value of each of them in particular, we must first learn to distinguish angeioleucitis from every other form of inflammation.

1°. General bleeding, which is proper in the commencement when the patient is young and robust, and there is fever present, is useless when the reaction is slight; and generally hurtful, when the period of suppuration has arrived, and at all times in the majority of aged persons, or of those whose constitutions are worn out. Leeches applied in considerable numbers over the sites of the inflammation, are either useful or hurtful under similar circumstances. When applied towards the root of a limb, in the vicinity of the engorged ganglions, they will be often found sufficient, for this simple reason, that rest, regimen, and simple external applications will cure angeioleucitis in a vast number of cases, and when attacked in the first stage.

2°. Emollient poultices applied over the solutions of continuity, and compresses of the same kind over the erysipelatous streaks, which are the only proper topical applications, while the patient is kept to the antiphlogistic plan, are of themselves but of little value when the disease is deep and extensive. Purgatives, in the beginning, aggravate the mischief; they are useful only in the subsequent stages, and then merely as accessory means.

3°. I have tried blisters: when employed in the usual way, they are altogether incapable of extinguishing or stopping the inflammation. Their action, when applied over the prominent points of the indurated masses, is limited to the hastening, or determining the suppuration or the resolution, which till then seemed uncertain. When, on the other hand, I have employed them to an extent that would really seem monstrous, the effects produced have been almost miraculous. I am not afraid, for example, to envelope the whole limb, from the shoulder to the fingers, or from the groin to the knee, and from the knee to the toes. The general and local symptoms are, by this treatment, arrested so rapidly, that in a week or two, a resolution which could scarcely have been expected, is effected. This plan of treatment may justly be considered as heroic.

4°. It will serve no good purpose to riddle the part with long and deep incisions before suppuration is established. As soon however as the matter can be ascertained to exist, issue must be freely given to it at once: the object now is to get rid of the secreted matter, and not, as in phlegmonous erysipelas to prevent suppuration. Frictions with iodine are proper only towards the end, and where induration is most to be dreaded.

5°. When the pain is very intense, lotions containing laudanum, or any other narcotic ingredient may be of use to palliate; but they possess in reality no curative virtue.

6°. As yet, I have employed *cold water* only in two cases. The inflamed part was covered with compresses, which were maintained by a bandage for two days. They were kept continually wet with water at the ordinary temperature, in the same way as I have been long in the habit of treating various wounds; but the pain and swelling increased to such a degree, that I was compelled to give up its use. A little reflection will suffice to convince us that an inflammation which occupies so many distinct points, and which is scattered in patches, filaments, and cores, situated at various depths, can but very rarely be checked by topical refrigerants. We have therefore to examine the effects of compression and mercurial inunctions.

7°. If the angeioleucitis be superficial, and extend more in surface than depth, compression properly applied may effect a resolution in a few days, when it is possible to make the pressure over all the affected points, and provided no suppuration has yet taken place. Under different circumstances, it will in general prove useless, and possibly aggravate the mischief.

But there can be no doubt of its efficacy, on the other hand when the purulent collections have been opened, and the tumefaction and inflammatory doughyness begin to assume some of the characters of œdema.

8°. While I was endeavouring to reconcile results so contradictory as those which different practitioners have said they had obtained by *mercurial inunction* in the treatment of erysipelas, it struck me, that my object would be realized by supposing that this mode of treatment, which is really valuable when applied to inflammation of the lymphatics, might be wholly useless in the inflammations of the skin and cellular tissue, strictly so called. On this point, the presumption has hitherto been but imperfectly sustained by facts. The tumefaction of the ganglions, the red streaks, and bands of the skin, and the pain of the part have constantly diminished from the first day, under the influence of the mercurial ointment. The same thing was remarked, as regarded the general tumefaction, and the other phenomena of inflammation, in three patients in whom the resolution appeared to have been produced by the remedy; but in twelve other cases, the suppuration took place in the same manner as it occurs under the other modes of treatment which are so much extolled. Possibly, however, I might have the right to conclude, from the trials I have made of it, that mercurial inunction acts as a powerful discutient on the inflamed lymphatic vessels and ganglions, although it will have but little effect against the concomitant inflammation of the interposed tissues. I must acknowledge, however, that we must still refer to experience on this point. I can, however, say with certainty that the mercurial ointment has no other effect than that of soiling the linen in simple erysipelas, and that its efficacy in angeioleucitis is very doubtful.

I subjoin the plan of treatment which has appeared to me to be the most successful. If any wound exist, whether it be recent or of long standing, it is covered with a thick poultice: if there be any arterial reaction, recourse is had to general bleeding; the quantity abstracted to be somewhat considerable; to be followed up by the use of a tepid bath for an hour; twenty or thirty leeches are applied round the wound, when it appears red and swollen. After these means, compression with a roller will be of use; its action will be promoted by wetting it several times during the day with some resolvent fluid. Cold water perhaps would answer very well in this way. If compression is not followed by the desired effect, mercurial inunction is indicated. The plan I pursue is to have two drachms rubbed in three times in twenty-four hours, over the entire extent of, and a little beyond, the painful region. When the skin becomes surcharged with the ointment, it is easy to clear it again by means of a little oil, and then a second bath is taken. As soon as any fluctuation can be detected, no matter how obscure at any point, the bistouri must be made use of at once, all these abscesses requiring to be largely and promptly opened. At this stage, recourse may again be had to poultices over the suppurating points, and to compression, if the form of the part will allow it. When resolution does not take place, and the suppuration is tardy, it will be right to employ blisters. They may be applied in succession, or simultaneously over the points where the inflammation was most intense, and which are still the most engorged. The larger the blisters, the more certain their good effects, acting either as the best maturatives, or the best resolvents that I know of. In many such cases, I can speak decidedly as to their good effects; having succeeded, in a little time, by means of them, either in dispersing or producing suppuration in masses which seemed to be unalterably indurated. When there is delirium, or great agitation, I also employ them from the beginning; arranging them in such a manner as to cover over the whole of the diseased, together with some of the sound parts. They are removed in twenty-four hours with the epiderm, and the exposed parts are powdered with camphor, in order to protect the urinary passages. The dressing is completed with simple ointment spread on bibulous paper. Mercurial inunction and compression may be conjoined with these means after a few days.

A purgative every third or fourth day, for a week or two, towards the decline of the disease, will be found useful. But medicines of this class should be carefully avoided if diarrhœa or other signs of visceral irritation be present. At a still later period, when the wounds cease to suppurate, it is sometimes imperative to have recourse to friction with the ioduretted ointment, on account of the doughyness and induration which often persist in several points. Frictions, with small quantities of mercurial ointment, deserve the preference when the induration is extensive; and compression would be still better when it is possible to apply it. The use of the tepid bath is of great value. It need scarcely be added, that from beginning to end, the parts should be kept at rest, and that the regimen and diluents should be regulated according to the state of the bowels, and the degree of general reaction. The wounds, ulcers, and eschars resulting from angeioleucitis require the same treatment as under any other circumstances.

Chronic angeioleucitis.—In the chronic form, the inflammation of the lymphatic vessels present characters so very different from those of the acute angeioleucitis, that it is every where described under other appellations. As it forms, at least, an element, if not the principal lesion in a vast number of the chronic diseases of the skin, it will come more properly into the description of those diseases, but more especially in that of ELEPHANTIASIS.

(*Alf. A. L. M. Velpeau.*)

ANKLE, SURGICAL ANATOMY OF.

This word has seldom been clearly defined by anatomists or lexicographers, and for this reason has often been imperfectly understood or improperly employed[1].

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[1] Dr. Hooper and Dr. Joseph Fox have omitted this word in their Medical Dictionaries; Dr. Rees's Cyclopædia Britannica, and Dr. Todd's Cyclopædia of Anatomy, both commence the article thus: "ANKLE, SURGICAL ANATOMY OF, JOINT OF," &c. without explaining the meaning of that word. In popular language, this expression is often applied to the lowest and thinnest part of the leg, just above the malleole; more frequently it is used to denote the joint which unites the leg to the foot. This is Dr. Nathan Bailey's and Dr. S. Johnson's definition. Wiseman, one of our best early chirurgical writers, often employs it in this sense, and his example has been followed, more or less, down to the present day; nevertheless, this expression, which is as clear as it is precise, has been rendered obscure by authors applying it to the malleoli, and distinguishing them by the expression of outer and inner ankles. Wiseman and other authors make use of a still more objectionable expression,—such, for instance, as Ankle-bone, Ankle-bones. With a view, no doubt, of putting an end to all ambiguity, medical writers formed the compound word Ankle-joint, which is also an imperfect denomination. Ankle, according to its most common acceptation, meaning the tibio-tarsal articulation, it is evident that ankle-joint gives no additional strength or precision to the word, but, on the contrary, merely commits tautology; it is the same as saying, the joint of the joint which unites the leg to the foot: this word has another inconvenience; it supposes a difference between ankle and ankle-joint, which difference is nowhere to be found. The origin of this word is also unsettled: according to Samuel Johnson it is derived from the Anglo-Saxon *ancleop*, or from the Dutch *anckel*. As Johnson, however, was totally ignorant of all the Northern European languages, but slight reliance can be placed on his Teutonic derivations; as regards the word ankle, Dr. Johnson differs with Bailey, who says that it is taken from Anglo-Saxon *ancleop*, or

As no natural boundaries circumscribe the region of the ankle, artificial ones are assigned to it; it may be said to comprehend all those parts situated two fingers'-breadth below, and the same distance above, the lowest part of the extremity of the tibia and fibula. In this small space, objects of the highest practical interest present themselves. The diseases to which the ankle is liable are extremely numerous, very complicated, often highly dangerous, and very difficult of diagnosis.

Fig. 97.

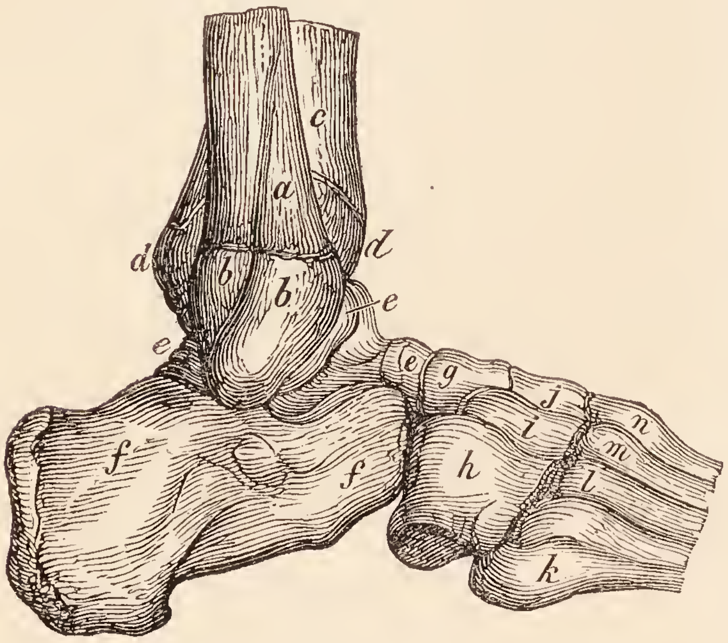

Fig. 97 *represents the exact form of the bones of the ankle, viewed from the external side. The subject from whom this foot was taken, was a young female adult whose limbs were extremely well formed. a, the fibula; b b, the lower extremity of the fibula or its epiphysis, the bone not being completely ossified where the transverse line passes across; c, the tibia; d d, the epiphysis or lower extremity of the tibia, the transverse line indicates its extent; e e e, the astragalus, which has four distinct articulations, one above, with the tibia, one lateral with the fibula, one below with the os calcis, and one before with the scaphoid bone; f f, os calcis or heel-bone; g, scaphoid bone; h, the cuboid bone, which is a little out of its place; in preparing this foot the cuboid was allowed to separate from the os calcis, it is therefore slightly depressed, and too far from the scaphoid and calcis; i, j, the third and second cuneiform bones; k, l, m, n, the metatarsal bones.*

As many valuable rules for the performance of surgical operations may be derived from an accurate knowledge of the outward forms of the human body, we feel it necessary to pay peculiar attention to this subject, which has not yet attracted all the attention it deserves.

The reader will bear in mind that as the outward forms are easily altered by a change in the position of the parts, we shall always describe the ankle region as it is when the leg is nearly at right angles with the foot, as in the vertical and standing position, and that our description is drawn from the male adult of ordinary stature; many inaccuracies will thus be avoided, which from not having attended to these preliminary considerations have found their way into works which treat of this subject.

The ankle region connects the leg to the foot, and presents an irregular oval form; four projections are easily observed in this region, which may be denominated the anterior, the posterior, and the two lateral projections. The diameter of these four opposite points is about equal. The anterior projection is most prominent towards the inside, and is formed by the tendons of the tibialis anticus, extensor longus pollicis pedis, extensor digitorum pedis, and peroneus tertius muscles; and not, as Mr. Brenan says, by the projection of the astragalus. In very muscular persons a slight depression is visible to the eye between the extensor pollicis and digitorum pedis muscles; this depression is felt very distinctly by the finger. On the inner side of the tibialis anticus tendon, the finger recognises a distinct hollow over which the large or internal saphena veins and nerves pass, and where the vein may be securely fixed for bleeding, especially if the pressure be directed towards the edge of the tibia. Many surgeons recommend fixing the vein against the smooth and convex surface of the internal malleole, where it generally slips away from the lancet. On the outside of the peroneus tertius tendon another slight hollow is seen, over which the external saphena vein and nerve mostly pass. If the above-named muscles be put into action, their tendons rise forwards, are much more prominent, and thus increase the antero-posterior diameter of the region. The extensor digitorum and peroneus tertius tendons being more firmly bound down by the annular ligament, are less visible and less displaced.

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from the Danish *ankle* (not Dutch). It is rather singular that both these lexicographers should have written this last word differently and incorrectly, especially so as the one copied the other. In the Danish language the word is spelt *ankel* (not *anckel* or *ankle*), and, according to its present anatomical sense, always means the malleoli; it is the *knöchel* of the German, and the *cheville du pied* of the French. In the Dutch it is written "*de enkel*." If the word be derived from the Anglo-Saxon, it ought to be written with a *e*; if from the Danish with a *k*; at present its orthography is quite unfixed, no good reason having been given why one or the other should in preference be used; but whether the word be of Danish or Anglo-Saxon origin, it is easy to show that anatomists have not often given a clear definition of it: we take, for instance, a very popular work on anatomy, where, at p. 65, we read the following lines:—"The lower head of the fibula is broad and flat, and is let pretty deep into a socket on the side of the tibia; together they form the ancle-joint for receiving the bones of the foot." It is quite evident that Mr. Bell here tells us that the ankle-joint is formed by the fibula and the socket in the side of the tibia; no doubt also, Mr. Bell intended to say, the lower part of the fibula with the lower part of the tibia form the ankle-joint. At page 68, however, our author very properly increases the number of bones to three—the tibia, fibula, and astragalus—which is generally the definition of this joint. Weitbrecht, in his splendid Treatise on Ligaments (not yet surpassed by recent writers), which the illustrious Haller honoured by calling "insigne opus," very properly tells us that this articulation is not entirely formed by these three bones. We have followed his example; and under the term "ankle" we comprehend all those parts which contribute to strengthen this joint and region.

Fig. 98.

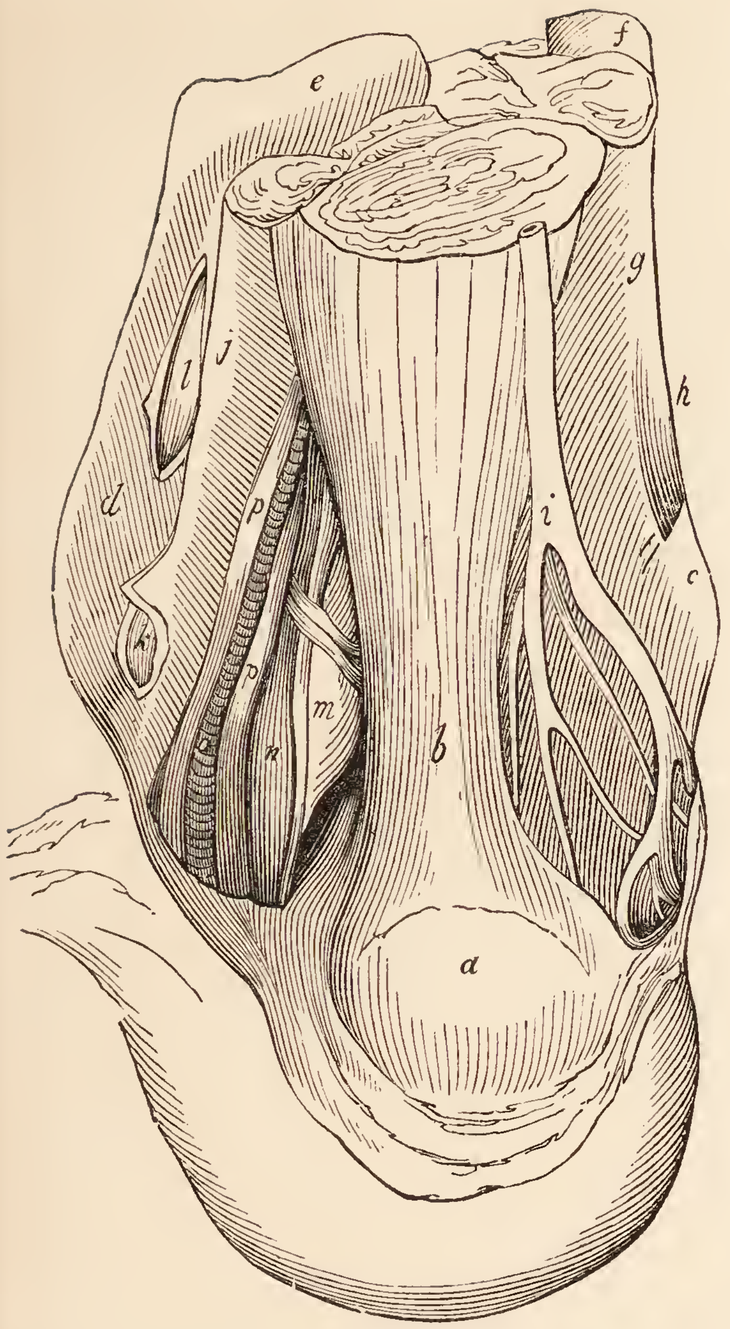

Fig. 98 *represents the anatomy of the posterior part of the ankle region. a, os calcis; b, the tendo Achillis at its narrowest part, where it should always be divided; c, external malleolus; d, internal malleolus; e, tibia; f, fibula; g, the peroneus longus muscle; h, its tendon, exposed by cutting off a portion of the aponeurosis; i, the external or posterior saphena vein and nerve behind it; j, flexor digitorum pedis; k, its tendon in its sheath; l, tendon of the tibialis posticus muscle; m, the flexor longus pollicis pedis, covered in part by the posterior tibial nerve and vessels; n, posterior tibial nerve, with an anterior division passing above the main trunk; o, the posterior tibial artery partly covered by its two veins; p p, posterior tibial veins.*

The posterior projection is formed entirely by the tendo Achillis and adipose tissue; the narrowest part of this eminence is at about one inch from the top of the posterior extremity of the os calcis; it is here also that the rupture of this tendon takes place, and where the surgeon ought always to divide it for the cure of club-foot. This tendon presents a slight curve, which is directed towards the heel. During contraction of the gastrocnemii muscles this slight concavity somewhat disappears; in fact, this projection changes its form at every motion of the ankle; in the perpendicular posture of the leg, the tendo Achillis stands out from the tibia so as to increase the depth of the hollow spaces on each side of it,—when the knee is forcibly bent forwards upon the foot, the posterior projection is much diminished by the tendon lying close upon the deep-seated parts of this region. The internal malleole forms the inner and lateral projection of the ankle; its broadest part measures about one inch and a half, and is most prominent at its lowest part, where it presents a convex and regular border, bounded below, in all its extent, by a depression which may very appropriately be termed the submalleolar depression. The posterior border of this protuberance is rather acute to the touch, and forms the edge of the groove through which the tendon of the posterior tibial muscle passes; when this muscle acts, the tendon rises above the edge of the tibia, and may be followed by the eye an inch above and below the lower extremity of the bone. The external malleole, which forms the outer and lateral eminence, is the most prominent of the region; its shape is more irregular than that of the opposite malleole, is more posterior than it, and descends lower, giving in this way considerable strength to the joint by wedging in the astragalus. The posterior and inferior extremity of this bone displays a small projection which hides the tendons of the peroneal muscles, which during muscular contraction rise much above the level of the fibula.

Immediately below and anteriorly is a constantly well marked depression, which is bounded above by the extremity of the fibula, below by the extensor digitorum brevis, outwardly by the tendons of the peroneal muscles, which are made very apparent by putting their muscles into action, and inwardly by the peroneus tertius; this hollow corresponds to the space between the astragalus and os calcis. The external, or small saphena vein, with its nerve, generally crosses the external malleole obliquely from behind forwards, and passes over the depression above described. Two other depressions are observed between the tendo Achillis and malleoles; in fact, these bony eminences may be considered as the cause of all the depressions which we observe here; they take off much from the oval form of the limb, and give great cast to the region; they are exceedingly varied in their size and inclination, and determine more than any other part, the beauty of the ankle. The outer hollow is the deepest, owing to the greater or more direct projection of the corresponding malleole. The external saphena vein and nerve sometimes reach the upper part of this excavated surface. The internal depression between the tibia and tendo Achillis, although less deep, is of greater importance to the surgeon, on account of the posterior tibial vessels passing through this hollow, and upon which he may be called to operate; the artery may generally be felt pulsating in about the middle of this space. The outward forms we have endeavoured to describe, are beautifully represented in many of the great masterpieces of Grecian art. The Knife-grinder or Slave, the two Wrestlers in the Tribune of Florence, the Dying Gladiator of the Capitol, the Nile and Laocoon of the Vatican, the

Hercules Farnese of Naples, the Discoboli of the Louvre, &c., are models of anatomical correctness, which we may in vain look for in the most perfect specimens of modern sculpture.

Fig. 99.

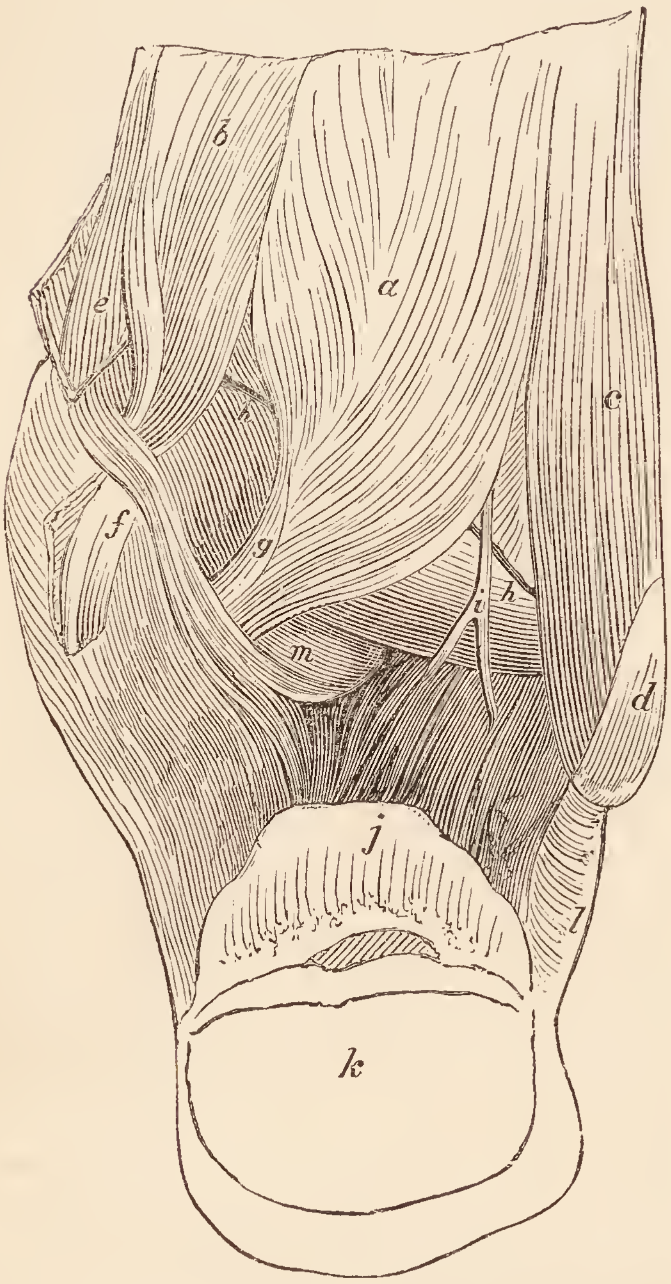

Fig. 99 *is meant to give an idea of the deep-seated parts behind the ankle, and also to show the exact upper limit of the tibia-tarsal articulation, which, in this situation, always appears so very high up. a, the flexor longus pollicis pedis, which lies directly upon the posterior ligament, and synovial membrane of the joint, which are protected by it; b, the flexor longus digitorum pedis also lies close upon the joint; between these two muscles, the posterior tibial vessels and nerves pass towards the foot; c, the peroneus longus muscle, which surrounds the back part of the fibula; d, the tendon of this muscle, which passes in the groove formed for it in the fibula, lying upon the tendon of the peroneus brevis, and with it passes into the sheath below marked l; e, tendon of the tibialis posticus muscle, which is covered by the flexor digitorum pedis muscle; f, the tendon of the flexor digitorum muscle exposed by cutting open its vagina; g, tendon of the flexor pollicis pedis; h h, the articulation of the tibia; i, the peroneal artery; j, the cartilaginous semicircular extremity of the calcis, upon which the tendon Achillis passes; k, the posterior extremity of the calcis; m, the lowest and most prominent part of the posterior surface of the astragalus; this projection may generally be felt: between the spaces which are formed by the separation of the muscles, a quantity of adipose tissue exists.*

The skin which covers the ankle presents but slight differences to the surgeon's eye. It is thinner upon the surface of the malleoles than elsewhere, more extensible and more easily folded in front than in any other part; it is less extensible upon the inner than upon the outer ankle, owing to the skin being more firmly connected to the fascia beneath by fibrous tissue, which is inserted into the plantar aponeurosis. As in the vicinity of all other joints, where constant flexion and extension occurs, it presents transverse folds or rugæ before and behind the ankle; in both these aspects also, it is thicker than elsewhere, especially in front, and among the working classes, in whom accidental bursæ mucosæ are here sometimes observed.

The skin lying immediately upon the hard and resisting surface of the malleoles is frequently exposed to injuries from blows, or by fractures of those bones; varicose veins, by ulcerating, often produce sores in this region, which are very troublesome and difficult to heal. In all operations upon the ankle region, and particularly above the malleoles, the surgeon should always remove as little skin as possible, for wounds are constantly more difficult to cure in proportion to the degree of tension and motion of the integuments. In consideration of the transverse rugæ in front of the ankle, Mr. Brenan advises in opening this part to discharge matter, to make the incision transversely; but as there is much flexion and extension in this part, the lips of the wound are much more liable to be separated when we make a transverse, than a vertical incision.

In order to avoid large superficial veins in our operations upon the ankle (as in every other part), the surgeon should always apply a bandage round the leg, when the veins will become apparent, and their exact situation may be noted down, by marking their course with ink; by proceeding thus, many veins can be spared which surgeons are every day wounding unnecessarily.

The sub-cutaneous cellular and adipose tissue of the ankle is bound down in front or connected by means of aponeurotic fibres to the annular ligament, and thus any great accumulation of fat in this situation is prevented, which would evidently impede the motions of the foot and ankle; for this reason also, in children, and fat persons, a transverse furrow seems to pass across the ankle, just below the lower extremity of the tibia; the adipose tissue rising above and below this furrow, renders it still more remarkable. The submalleolar depressions also contain adipose and cellular tissue, which is here also liable to be the seat of œdema. The greatest quantity of adipose tissue is found near the tendo Achillis, and in the posterior lateral furrows, especially in females, where, by its great accumulation, it produces many changes in the forms, and, when in excess, completely destroys the beauty of their outlines. It is not the object of surgical anatomy to describe the minute and superficial vessels and nerves which are found in this region. The surgeon should, however, endeavour to avoid the musculo-cutaneous nerve, which passes before the ankle, having first divided into two or more branches which below the joint anastomose together by oblique communications.

The fascia or aponeurosis of the ankle region is the continuation of the same subcutaneous envelop of the leg; its office is similar, to keep each part in its proper place; but as there is more danger of displacement of the numerous tendons in this situation, so the fascia is much stronger, and by dividing into several layers forms complete sheaths through which these tendons pass. Although these tendons are so firmly bound down by their vaginæ, yet, by great muscular contraction, these have been ruptured, and thus have the tendons been displaced. Wilson was particularly fortunate in seeing several such cases, and this led him to speak of this accident as a common occurrence, while few other authors speak of it. When the peronei tendons slide over the fore part of the fibula, their action, says he, "is changed; in this new situation their action on the foot will be to bend it on the leg, when in their natural position, it was to extend it:" he adds, "that these tendons may easily be pushed into their proper places, if done soon after the accident, but if not done early, they form a new groove on the fore part of the bone, and the old one is filled up, or otherwise so altered that it cannot again receive them; and thus the pain and lameness may continue for life." "I have seen," he continues, "this occurrence in the living body early enough to return the tendon." In another case, when this could not be effected, he recommended the removal of a portion of the tendon, which was done, and followed by no inconvenience. The same anatomist saw two or three subjects in the dissecting-rooms, which presented similar displacements of these tendons. "The tendons which pass behind the inner ankle are liable to a like displacement." Dr. Adams (Dr. Todd's Cyclopædia of Anatomy, Art. ANKLE) has seen one instance of this displacement and several of the former.

An accurate knowledge of these sheaths, which often inflame, and require opening by the knife, is indispensable to the practitioner: ignorance of this subject frequently leads to disastrous consequences[1]. If, for instance, where matter is pent up, an incision be made on the inside of these sheaths without penetrating them, little or no relief will be obtained; the pus still remains in the vaginæ of these tendons.

All the tendons in this region are provided with sheaths, which are lined where much friction exists with synovial membranes or bursæ mucosæ, which, by their great smoothness, contribute much to the facility of motion. These membranes are frequently diseased; sometimes they are distended by fluid forming tumours in different parts of the ankle, according to their situation; this is the most innocent of the affections to which they are liable; they may generally be cured by applying sudden and powerful pressure, sufficient to rupture the bursa; the fluid then becomes absorbed. These tumours frequently present some difficulty of diagnosis to the practitioner, where they are deep-seated, and especially when he is not familiar with the precise situation of the bursæ. Despite of the assiduous and extensive cultivation of anatomy, some parts of the human body attract but little notice; of this, the bursæ mucosæ offer us an example. Few observations appear to have been made regarding these membranes; and the best work which we have upon this subject, is perhaps still, Alexander Monro's valuable treatise, which J. C. Rosenmüller translated into German, in 1799. It is also rather singular that many authors have given representations of these bursæ, very inferior to those which are found in the above-named book. Thus, Caldani in his large engravings has sometimes copied (plate 89) Loder's drawings, which are very inferior in correctness of anatomy to those of Alexander Monro. MM. Bourgery and Jacob, in their splendid work on anatomy, have not done justice to this part of the subject. The best way to study these bursæ mucosæ is to inflate them by means of the blow-pipe. We thus obtain the following dimensions:—At the inside and front of the ankle, we find the tendon of the tibialis anticus muscle, which is generally covered by the cellulo-adipose tissue, and always provided with a large bursa extending two inches above the lowest part of the internal malleole, and one inch below the same part; its length is sometimes much greater,—when amply distended, its width is nearly an inch: the anterior annular ligament, which furnishes this bursa with a sheath, does not bind it down so tightly as it does the other bursa of this region; the finger may easily appreciate the distension of the bursa through the skin. These synovial membranes are generally inserted along the posterior border of the tendons, but not throughout their extent, leaving here and there small spaces, which are mostly of a semicircular form; at each extremity, these membranes present distinct folds, which surround the tendons, and sometimes part of the muscle. These attachments explain why the slightest motion produces such acute pain in cases of inflammation of these bursæ.

The extensor pollicis pedis tendon is surrounded by a large synovial membrane which measures three inches in length and nearly one inch in breadth. I have seen this bursa measure four inches and a half in length; it does not reach so high up the leg as the one just described, but extends much further below, sometimes to within one inch and a half of the articulation of the great toe; the sheath which the annular ligament forms for this tendon is strong and binds it down, so that the bursa when distended is felt more easily above and below the annular ligament, than at its middle, where it offers its greatest thickness.

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[1] In suppuration of the synovial membranes it sometimes happens that the tendons slough away. M. Roux saw the peronei tendons come away in a severe case of inflammation of the foot and synovial membrane.

The anterior tibial artery with its veins and nerve passes down towards the foot, first close behind this bursa of the extensor longus pollicis pedis, then towards its outer side just before it reaches the inner side of the extensor brevis digitorum pedis; in this situation the artery may be tied without injuring the bursæ, if great care be taken. If, on the contrary, this vessel be laid bare while it passes behind the strongest portion of the annular ligament, or even above it, as many anatomists recommend with the idea of avoiding the bursa, invariably the synovial membrane of the extensor pollicis, or of the extensor communis digitorum pedis, will be wounded. In laying stress upon the danger of injuring these bursæ which are situated near the artery, we do not wish to create difficulties for the young operator, but merely to prove that an imperfect knowledge of the situation and extent of these bursæ has caused many errors. For I am well aware that this vessel has been tied several times when no doubt the bursa has been opened, and without endangering the patient's life. Besides, many cases exist, where from accidents, the synovial membranes have been severely wounded, and the patients have, nevertheless, promptly recovered. Very lately, an opportunity occurred of witnessing a severe injury of this sort in my friend M. Donné, the laborious and intelligent author of some interesting papers on microscopical observations, who, while washing his feet, fell through the vase, and thus had both his peronei tendons divided low down; he recovered their use perfectly.

The extensor L. digitorum pedis and peroneus tertius tendons pass in the same sheath, and are, therefore, provided with a common bursa, which is the broadest and shortest in the region; it is about two inches long, extends one inch above the extremity of the malleole, and below, as far as the separation of the tendons one from the other. When distended, it is visibly bound down by the anterior annular ligament, to which it is so adherent that it cannot be easily detached; as this ligament forms a sort of strangulation about the middle of the bursa, the surgeon should always examine above and below this point, when he suspects an accumulation of fluid. The three bursæ just described are constantly found in this region; others, or accidental bursæ, are sometimes discovered in this part. A superficial or subcutaneous bursa mucosa, lying upon the extensor pollicis and digitorum pedis is here met with in cases where considerable pressure has existed above the part; whether these accidental bursæ are of the same nature as the others, I am not at present prepared to decide; however, this bursa is about one inch in length. Another irregular or accidental bursa is sometimes situated upon the astragalus or scaphoid bone, produced probably also by pressure. In the posterior side of this region we find four more bursæ mucosæ, which are situated more deeply than those in front. The tendon of the tibialis posticus muscle, which is the first we discover on the inner side of the ankle, is enveloped by a bursa mucosa which reaches four inches above the lower extremity of the malleole; when distended, the finger may feel it distinctly through the integuments; it rises above the edge of the tibia. The flexor longus digitorum pedis bursa envelopes a portion of the muscular fibres as well as the tendon, and lies partly behind the posterior tibial vessels; for this reason care must be also taken to avoid injuring it.

The flexor longus pollicis pedis bursa covers about an inch of its fibres before its tendon passes the strong vagina; this bursa is extremely thin, and lies immediately behind the posterior tibial vessels and nerves; great care must be taken not to injure it during operations upon these parts.

Proceeding outwards, we observe the bursa of the peronei tendons, which, passing in one sheath, have only one synovial membrane. This bursa is large, rises, when inflated, above the edge of the fibula, can easily be felt by the finger, and extends two inches and a half above the lower extremity of the malleole. In examining the foot of a man who had fallen from a scaffold, I perceived along the course of this bursa, a peculiar sort of emphysematous crepitus: by carefully studying this sensation, I concluded that it was produced by a fluid passing under the fingers; the dissection discovered a fracture of the calcis, rupture of the bursa, which was filled with blood, and an incomplete fracture of the external malleole. I feel quite persuaded that minute inspection of these bursæ will often lead to the diagnosis of similar fractures, and assist in discovering other diseases. A patient was lately sent me, that I might examine his fore-arm, when a very singular crepitation was observed, which seemed to extend along the course of the long muscles of the thumb, and was probably caused by fluid in their bursa which lies above the radius.

Fig. 100.

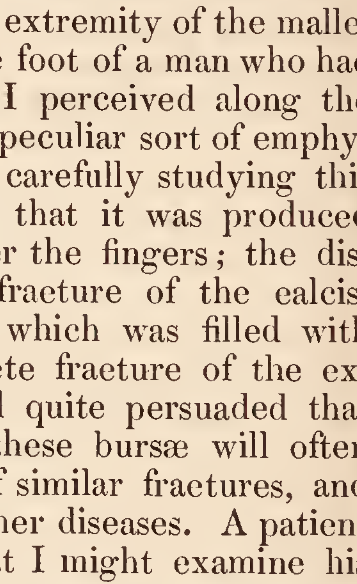

Fig. 100 *is a vertical section of the bones of the ankle. a, the os calcis; b, the astragalus; c, the epiphysis of the fibula; d, the epiphysis of the tibia; e, the external lateral ligament, descending from the fibula to the os calcis; just within it the line is prolonged to show the interosseous ligament connecting the fibula with the astragalus. The interosseous ligament is also seen connecting the astragalus and os calcis. Between d and b, the internal lateral ligament is stretched from the tibia to the astragalus.*

The articulation of the ankle is formed by three bones, the tibia, fibula, and astragalus; but as Weitbrecht very justly observes, "nihilominus tamen ligamenta, quæ pedem in junctura hac coercent, non soli talo (seu astragalo) innascuntur, sed et aliis ossibus, nimirum calcaneo et osse naviculari, quæ ossa vicissim per alia ligamenta sub loco commemoranda cum ipso astragalo firmiter combinantur."—(p. 159, loco cit.) The tibia and fibula form together a cavity which receives the pulley-like surface of the astragalus, and thus presents one of the purest hinge-joints of the human body. This articulation, like that of the occipital bone and atlas, is united at nearly right angles, a fact which destroys that analogy which is generally established between the wrist and ankle. The ankle is beautifully constructed for its purposes, great solidity and motion.

With regard to the movements which take place in this joint, much difference of opinion exists. Some anatomists maintain that three motions can be performed in the tibio-tarsal articulation; viz. flexion, extension, and lateral motion; others deny the possibility of the last; and some allow lateral motion, only under peculiar positions of the limb. Thus Wilson, who was a very good anatomist, asserts that the joint of the ankle permits no rotatory motion when the foot is either bent or at right angles to the leg; but when the leg is raised and the foot is extended, a narrow portion of the astragalus is brought into the hollow formed by the bones of the leg, so that the toe can be pointed to either side." (Wilson loco cit. p. 156.) This is also the opinion of Mr. B. Cooper, and of many other good anatomists: it is, nevertheless, incorrect. I have endeavoured repeatedly to produce this lateral motion on the fresh subject as well as on the living body, but have never yet succeeded; in whatever position the limb be placed (when healthy) the two malleoles always prevent this lateral motion, by pressing against the sides of the astragalus. Winslow, a most accurate anatomist, now too little read, has given by far the most perfect description of the different motions of the foot; and he decidedly affirms that flexion and extension are the only movements permitted in this joint. By admitting this lateral motion, authors have been induced to attribute more or less mobility to the peroneo-tibial articulation, which is described as being covered with cartilage throughout its extent: this is also an erroneous notion—a very small part of this articulation is provided with cartilage; a synovial membrane and cellular tissue separate these two bones; all that appears necessary here, is to prevent sudden concussion of the bones; and, therefore, a sort of elasticity is procured by the cellular tissue which is interposed between them. It is impossible to examine the various erroneous views regarding the motions of the foot and ankle in the present paper; we must, therefore, confine ourselves to the following brief observations, which will be corroborated by various pathological facts:—Flexion and extension are the only visible movements of the tibio-astragalian joint. Rotation, or abduction and adduction of the foot, are produced principally within the articulation of the astragalus and os calcis, and a certain degree of similar motion occurs between these two bones and the scaphoid and cuboid bones. The anatomical inspection of these joints, and the direction of many of their ligaments, suffice to set this subject at rest; the contrary opinion can only be maintained by those who are in the vicious habit of studying the bones in their dried state. The upper part of the calcis is admirably adapted for its two-fold office, of bearing the weight of the body and of allowing considerable lateral motion of the foot upon the leg; thus its upper surface is divided into three or four articular portions, each separated by a layer of adipose tissue, meant, no doubt, to serve as an elastic cushion for the astragalus, and also to diminish the danger of fracture of this bone, which would probably occur if it were not thus divided, so as to disperse the force of sudden concussions upon its surface.

Fig. 101.

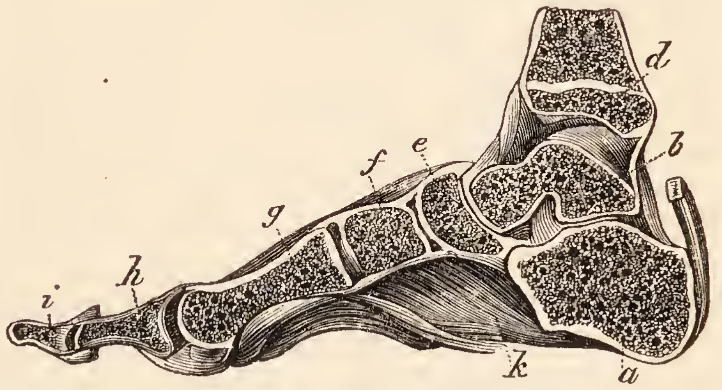

Fig. 101 *is a section of the foot, passing through the tibia, astragalus, os calcis, the scaphoid, internal cuneiform, first metatarsal, and phalanges of the great toe, and showing the interior of the several articulations; a, the os calcis; b, the astragalus; d, the tibia; e, the scaphoid; f, the cuneiform; g, the metatarsal bone; h and i, the phalanges; k, the muscles of the sole of the foot.*

If we take a glance at the numerous disorders of this joint, we find none more common than sprains, and yet we possess very little positive knowledge respecting their precise seat and nature; hence we may expect a great diversity of opinion. Some authors maintain, that in all violent sprains the ligaments of the tibio-astragalian joint are torn from their bony insertions; others assert, that the ligaments give way in their middle. Dupuytren, who had several opportunities of dissecting subjects which presented these accidents, tells us that when sprains are not carried to any extent, the ligaments are merely stretched; on the contrary, when sprains are violent, the lateral ligaments are torn from one or both the malleoles. Wilson, on the other hand, speaking also from his dissections, informs us, that he found "the capsular ligament of the ankle-joint, and one of the lateral ligaments binding the tibia to the foot, lacerated." In another case, Wilson found the ligaments thickened, and their pliability greatly diminished[1]. M. Cruveilhier, who places nearly the whole of the rotatory motion of the foot in the articulation of the cuboid and scaphoid bones, with the calcis and astragalus, has published the most extraordinary views of these sprains. At page 490, vol. i. of his work on anatomy, he states, "that sprains which are produced by violent and sudden motions of the foot, either inwards or outwards, occur in the above named quadruple articulation, and not in the tibio-tarsal-joint." This exclusive motion is as inconsistent with experience as it is with reason. We are far from rejecting the possibility of sprains existing in that joint, and believe this accident may occur wherever there is motion, because it is frequently caused by violent efforts or exaggerated movements, as well as false steps. Although we have no facts to sustain our opinion, we are inclined to believe that sprains sometimes occur between the os calcis and astragalus, where so much motion is constantly taking place. We cannot leave this subject without exhorting surgeons never to allow any opportunity to escape of minutely examining the nature and seat of this disorder, and of carefully recording the result of their observations.

Dislocation of the ankle is a subject of too vast importance to be treated of in this paper; instead, therefore, of following our predecessors, (the American Cyclopædia of Practical Surgery, and Dr. Todd's Cyclopædia of Anatomy, where, under "Ankle," all the dislocations of that joint are explained,) we shall merely speak of certain parts of this subject, referring for the rest to the article "Luxation." Celsus admitted four sorts of dislocations, "talus in omnes partes prolabitur," forwards, backwards, inwards, and outwards; most English writers, from Wiseman down to the present time, have followed his classification. Dr. John Aitkin, in his "Essays on Fractures and Luxations," published in 1789, says, "that a backward and forward luxation takes place in the ankle-joint," but never even mentions the lateral dislocations, which are the most common; while, on the other hand, the best authors generally admit the possibility of the backward dislocation.

Notwithstanding the perfect construction of the ankle-joint, the numerous ligaments which bind the various bones together, the strong tendons, their sheaths, and their different layers of fasciæ which greatly contribute to the solidity of the ankle, still violent motions set all these wise precautions of nature at defiance, and produce the most painful and formidable accidents. Dislocations of the ankle are frequently the cause of simultaneous fractures of the tibia or fibula. Some confusion exists regarding the nomenclature of these dislocations; they are sometimes called luxations of the ankle, luxations of the leg, and luxations of the foot. Foreign writers invariably prefer using the expression, "Dislocation of the foot," therefore care must be taken not to confound these cases, which always correspond to the opposite ones in our nomenclature; for instance, dislocation of the foot forwards would be our luxation of the leg backwards, &c. &c. If we take the astragalus as our guide, we find that this bone can be displaced under very different conditions:—1. It may be separated from the tibia and fibula, and thus afford one example of luxation of the foot or leg. 2. It may maintain its natural position in the cavity of the tibia and fibula, and be separated from its lower articulation with the os calcis, and thus present another form of dislocation of the foot. 3. It may break through all its bands of union, and, as it were, shoot completely out of its place; and, lastly, it may be partially displaced. This last variety is not familiar to many surgeons, and has seldom been noticed by authors. That admirable writer, Jean Louis Petit, is among the first who have spoken of it. M. Roux has kindly permitted me to make use of a manuscript memoir upon this subject, in which he relates the history of four cases of imperfect dislocation of the astragalus. "In all these cases," says M. Roux, "I found the small head of the astragalus dislocated forwards and outwards upon the cuboid bone; the astragalus maintained its position with regard to the tibia and fibula, these bones were not fractured in three of the patients; in fact, the palpable displacement here is caused by the small head of the astragalus leaving the cavity of the scaphoid bone." It might, as this skilful surgeon suggests, be called the most simple form of dislocation. The first case that came under M. Roux's observation was that of a young female, who was admitted into La Charité. Several days after the accident, there was a tumour situated above the cuboid bone, which, by pressing against the skin, had already caused an incipient state of ulceration; the foot was much inflamed, and the great pain which the slightest motion of the limb gave rise to, prevented an attempt at reduction being made. Suppuration around the bone followed, the cartilage which covers the head of the astragalus came away, and the patient recovered: the limb, however, was still very painful and of little use. Some months after this accident, the patient applied to Dupuytren—he at once proposed an operation, which he found most difficult and laborious; he removed the whole of the astragalus. The result was fatal. The second case was that of a middle-aged lady, who, falling down stairs, dislocated the small head of the astragalus, which was easily felt above the cuboid bone. The accident had but just occurred when M. Roux saw her: he applied extension to the foot, and, pressing the head of the astragalus towards its natural situation, "reduced the dislocation with comparative ease." The third observation is that of an Englishman, who, in falling from his horse, met with a similar accident. M. Roux, in conjunction with two other surgeons, endeavoured in vain for a long time to replace the bone; attempts of every sort were made to reduce this dislocation; at last, and without knowing how or why, the bone was reduced; this case is valuable, in as much as it shows the difficulty similar accidents may present. The last opportunity M. Roux had of seeing this accident, occurred in a man who fell from a ladder; there was a compound fracture of the malleole, and a dislocation of the small head of the astragalus upon the cuboid bone. There was too much swelling and inflammation to make a trial at reduction. The foot suppurated; M. Roux entertained hopes that he might saw off the dislocated part of the astragalus; the suppuration however continued, amputation of the leg became indispensable, and the patient died.

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[1] Lectures on the Diseases of the Bones, 1820, p. 297.

These interesting observations naturally suggest a few questions; for instance, it may be asked, why was the head of the astragalus thrown outwards upon the cuboid bone in all these cases? Anatomy will assist, I think, in explaining this circumstance. If the os calcis be made to rotate upwards and inwards, the small head of the astragalus becomes prominent above the scaphoid bone, and is directed outwards towards the cuboid bone; this fact is so evident on the fresh foot, (and may easily be verified upon the living subject), that one is not surprised that such displacement should occur. The ligaments uniting the astragalus to the navicular bone are stronger on the inner than upon the outer side. The astragalus must also have greater difficulty in passing over the scaphoid bone on account of its being a little above the cuboid; there is likewise a slight depression between these two bones where the astragalus perhaps escapes. The tendons of the tibialis anticus, extensor pollicis pedis, extensor digitorum, and peroneus tertius muscles, their sheaths, and the annular ligament, must tend to prevent the bone from escaping in that direction; on the cuboid side there are no such impediments. Another question also arises, and which regards the position of the astragalus with the calcis, or whether the small head of the astragalus can be thrown so far out of its situation, without changing its natural position with that bone. Is the interosseous ligament torn or merely stretched? I have explained these views to M. Roux who entirely agrees with them. In Chassaignac and Richelot's translation of Sir A. Cooper's surgical works, are recorded a number of interesting facts concerning simple and compound dislocations of the astragalus. Dr. Valentine Mott of New York has favoured me with two cases of complete dislocation of this bone which are worthy of notice.

"A man, aged thirty-two, fell from a considerable height upon his feet, and dislocated one ankle compoundly. The astragalus was thrown forwards upon the tarsus, and so entirely detached from all its proper connexions, that it was removed. This man recovered without any of the severe symptoms which usually attend an ordinary compound dislocation of this joint. He walked upon the foot afterwards, having considerable motion preserved in the joint."

"Another man, aged twenty-five, received a similar accident, but the astragalus was not so completely detached from its ligaments. He would not permit it to be removed. He recovered much more lingeringly from the injury, and not without severe symptoms. The bone exfoliated, and he was ultimately able to walk upon this foot."

We shall now examine another contested point in the history of dislocations of the ankle. The existence of a luxation of the foot forwards, or, as we call it, of the leg or ankle backwards, has been denied by many authors. Its occurrence is extremely rare; Boyer, Dupuytren, Sir A. Cooper, Mr. B. Cooper, Dr. Mott, and M. Roux, admit its possibility, but have never met with it in their practice. Dr. Adams, who has written "the Abnormal Condition of the Ankle," in Dr. Todd's Cyclopædia of Anatomy, relates a case of partial luxation of the tibia backwards, which was communicated to him by that practical surgeon, Dr. Colles of Dublin. "In this case the tibia seemed thrown *partially backwards* from the articular pulley of the astragalus, the fibula was unbroken, and was carried backwards with the tibia; the foot, measured from the instep upon its dorsum, was longer than that of the opposite side; the heel was shorter and less pointed; the space in front of the tendo Achillis, near the os calcis was partially filled up; and a hard swelling occupied the lower and back part of the tibia, which was evidently formed by a quantity of callus which had cemented together the fragments of a fracture of the lowest part of the tibia. The leg was shorter than the opposite limb," p. 162.

The anatomy of the posterior region of the ankle somewhat explains why complete and sudden dislocation of the leg backwards so seldom occurs. On the contrary, partial luxation of the tibia backwards, produced gradually, by various causes, is more common than is perhaps generally supposed.

The thickness of the malleoles should also be examined by the surgeon, for in such cases where partial necrosis, fistulous cavities, tuberculous deposits, &c. affect them, he may be enabled to remove a part of this bone, where it will be highly dangerous to penetrate the synovial membrane of the joint; about half of the thickness of these projecting bones may be removed by means of M. Martin's ingenious circular saw, which scoops out a concave hollow in such bones with great facility. I assisted my friend, M. Velpeau, in this operation where the diseased portion of the malleole was neatly removed. M. Velpeau has twice performed this operation. In one case the patient was cured: the other terminated fatally. On account of the great utility of the malleoles in keeping the astragalus firmly in its cavity, they should always be spared whenever prudence will allow.

M. Seutin, however, was obliged to remove the whole of the fibula, which was diseased throughout: I have seen this preparation, which is probably unique, at Brussels. The patient recovered, and could make use of his leg, which, as M. Seutin remarks, in the printed history of this bold operation, is a proof that the external malleole is not indispensably necessary for progression. M. Roux has also removed the whole of the shaft of the fibula, leaving behind the two extremities. Excision of the lower extremities of the tibia and fibula, rejected by many, is still performed by some enterprising surgeons. Mr. Syme, in his work on excision of bones, appears in favour of it. M. Roux has twice performed it; once fatally, and once with complete success—the patient can make use of his limb.

(*Claudius Tarral.*)

ANKYLOBLEPHARON: (from ἀγκύλη, 'a band, or bond of union,' and βλέφαρον, eyelid;) Any adhesion of the eyelids to each other. Adhesions generally take place at the outer canthus; they are less frequent at the inner; and they are very rarely observed either in the middle of the palpebral commissure, or at both its extremities at the same time. Occurring in such various forms, the ankyloblepharon is said to be *complete*, or *incomplete;* the former designation being reserved for those cases in which the occlusion of the lids is perfect throughout. The adhesion may, or may not be formed by the interposition of an adventitious tissue; in the first case the adhesion consists of a membranous band, more or less broad, and this is more especially the character of the congenital ankyloblepharon. Sometimes the adhesion assumes a trellis or lattice form, the opening between the eyelids appearing to consist of numerous small divisions. In other cases, there seems to be no uniting medium, the lids adhering by a faint white line of condensed cellular tissue. An ankyloblepharon is also described as *true* or *false;* the latter signifying the mere agglutination of the eyelids by sebaceous matter, which sometimes occurs. Here the real adhesion has not yet taken place, but it may be produced, more especially if psorophthalmia with excoriations, or any eruption, that of small-pox for instance, be present at the same time. Sometimes the adhesion is not confined to the eyelids alone, but extends to the eyeball itself. This latter form of adhesion is called *symblepharon*, and may exist without the former.

The diagnosis is established by introducing a smooth flexible probe under the eyelids. If the eyeball and lids be adherent, the patient is unable to move the former, and on every attempt to do so, the eyelid becomes wrinkled. The probe may also be used for this purpose, or the upper lid may be raised from the eye in a fold between the thumb and index-finger, and the patient directed to move the eyeball in every direction. If this can be accomplished, no symblepharon exists. It should, however, be observed, that this indication is often only decisive when the cicatrix extends through the whole eyelid, embracing at the same time both its inner and outer lamella. If the external lamella should not be closely united to the internal by effusion, the former may be raised in a fold, and the eyeball moved beneath it, even though symblepharon in reality exist. In such cases, certainty can only be arrived at by the introduction of a probe.

As the symblepharon is but another form of the same disease, it will not be out of place to include it under the same head, more especially as it presents the same varieties (according as it is complete or incomplete) of membranous frænula, bands, or extensive adhesion between the conjunctiva, and the eyeball. As regards the diagnosis, it is a point of much interest to ascertain if the patient can still distinguish light. If light be not perceived at all, and the globe of the eye is normal, we may conclude that the whole cornea participates in the adhesion. The imperfect symblepharon occurs most frequently in the upper lid.

An ankyloblepharon, even though only incomplete, produces not only great disfiguration, but injures the sight itself more or less particularly when it is of long standing, and extends to a considerable length of the tarsal margins. The retina, deprived of its natural stimulant, light, becomes gradually enfeebled, and paralysis ensues. In complete symblepharon, sight is lost altogether. In partial adhesion of the eyelids, squinting, or even complete obliquity of the eyeball in the direction opposite to the adhesion is often produced; or the palpebral openings assume a peculiar obliquity of direction similar to that of the Chinese. When the lachrymal puncta are closed, stillicidium of the tears, and dryness of the nostril take place on that side. When the disease is congenital, or of long standing, the eyeball frequently becomes atrophied.

The *causes* are either a primitive malformation, (and this case, which is of very rare occurrence, should be called *atresia* of the eyelids,) or adhesive inflammation, arising mostly from burns with quick-lime, gunpowder, boiling oil, steam, &c. The disease is also produced in psorophthalmia attended with excoriations. It was formerly often observed to occur from continually blindfolding in suppurative inflammations of the eyes, especially in small-pox and acute exanthemata, from traumatic lesions of the eye, or eyelids.

The disease is often complicated with other affections, which assume a cachectic, rheumatic, scrofulous, syphilitic, or impetiginous form; with malformations of the eyeball, in which it is small, irregular, or disfigured with cicatrices; with suffusion of the cornea, pannus, &c.

The prognosis depends on the causes, extent, and duration of the disease. Ankyloblepharon is more easily cured, when it has arisen from external, than from internal causes; and as regards situation, is more readily cured when it occupies the middle of the tarsal margins, than when it is situated in either canthus, or when it is complete. When in the outer canthus, it is often extremely difficult after operation to prevent the formation of a new adhesion. The success of the operation is more certain in widely slit eyelids, and prominent eyes, than it is under opposite conditions. Malformation, and an impellucid state of the cornea, or an extensive adhesion of them, often present insurmountable obstacles to the surgeon.

Treatment.—When, in inflammation, there is a tendency to form adhesions between the eyelids, or the eyelids and eyeball, the eye should be frequently opened in order to its being cleansed out by injections of tepid water; an eye-salve, or collyrium, may also be used. Beer prescribes the following to be used several times a day. ℞. Butir. recent. insals. ʒss.; Hydr. præcipitat. rubr. gr. viij.; Vitriol. alb. gr. 1. Tutiæ præparat. gr. x. A solution of Sacch. Saturni, or Zinci sulph. (gr. 1—2) and ʒi Aq. rosæ, with Tinct. opii ʒi. will also be very serviceable. Where the eyelids are already glued together, they should be separated with a probe.

Once formed, both the ankyloblepharon and the symblepharon can only be cured by a cutting operation. In the case of a congenital ankyloblepharon, the operation ought to be performed as soon as possible, in order to procure the admission of light into the eyes. The operation is also required in order to give facility for the application of remedies to the diseased cornea or eyeball. A complete and incurable deformation of the eyeball may also require an operation for the purpose of correcting the disfiguration by introducing an artificial eye. If any inflammation exist, it should be subdued, or any cachectic tendency of the organism, it should be corrected by appropriate remedies before the operation is performed. The operation is contra-indicated when the eyeball is incurably diseased, or malformed to such a degree that no artificial eye can be introduced.

The operation is performed in the following manner: the patient being placed, as in all operations on the eye, either reclining on a slightly elevated chair, or lying down, the upper lid is raised by an assistant, who stands behind the patient. The surgeon placed in front, draws the lower lid downwards with his fore finger, and making the uniting membrane tense, he introduces into the open part of the eyelid a small bistoury, somewhat concave on its cutting edge, and terminated in a fine probe-point two lines in length (Rosas). The bistoury is carried on slowly with its back turned to the eyeball until the adhesion is completely divided. The surgeon may also perform the operation by means of instruments of a different construction, such as a long, slender, probe-pointed bistoury, straight or curved; or a pair of probe-pointed curved scissors; or a probe-pointed director, curved on its smooth surface to the form of the eyeball, with a common bistoury. If the adhesion is established by means of an interposed adventitious membrane, the bistoury is carried as close as possible to the margin of one of the eyelids: this incision terminated, the membrane is detached from the other lid with the scissors. If the adhesion of the eyelids be complete, the assistant lays hold of the upper lid in a perpendicular fold, either in his fingers or with a pair of forceps, and raises it from the eyeball. The surgeon then seizes the inferior lid in the thumb and index-finger of his left hand, and divides the fold by a horizontal incision. Into the opening thus made, he introduces the probe-pointed director or bistoury, and the operation is completed as described above.

When symblepharon exists, the operation is performed at the same time. The upper lid being raised from the eyeball, the adhesions, or membranous bands, are divided with the scissors as closely as possible to the conjunctiva; they are then seized with a pair of forceps, and neatly cut away from the eyeball.

In many cases of symblepharon, the operation fails from the great tendency of the parts to reunite. In order to obviate this, Ammon has performed an ingenious operation on the principle of my method for producing adhesion of the cheeks with the gums. He cuts out a triangular flap from the centre of the eyelid, the base of which is formed by the tarsal margin; this flap is allowed to remain united upon the cornea. The lateral parts of the eyelid are now separated from the eyeball, and brought to unite over the triangular flap by the *sutura circumscissa*. When the margins are firmly united, the triangular flap covering the cornea is removed. After this process, there is but little tendency to reunion in the parts, but it is a plan that can only be adopted where the malformation of the eyelids is not considerable, and where they are not shortened and contracted. In a case of adhesion of the inferior lid with the eyeball, I operated in the following manner:—having separated the eyelid from the eyeball, I cut off the malformed tarsal margin, and formed a large flap of the skin between two parallel incisions, extending from the internal and external canthus downwards. I turned this flap inwards, and united its inner surface by means of sutures. After some time, when the conjunctiva of the eyeball became perfectly formed, I again separated the united inner surface of the flap, and raising it, I thus formed an inferior eyelid, which had no tendency whatever to form adhesions.

After arresting the bleeding by means of cold water, a few drops of pure mild oil are dropped between the eyelids. Several means have been proposed for preventing re-union, such as raising the eyelids by the introduction of loops of suture, or by the insertion between them of pieces of sheet-lead, goldbeater's skin, &c.; but these measures are too irritating. Some surgeons keep the eyelids asunder by means of strips of adhesive plaster; others touch the margins with nitrate of silver. Rosas recommends the operation to be performed after a long sleep, in order that the patient may be kept awake twenty-four hours; but this recommendation does not deserve serious consideration. He also introduces between the eyelids a plate of wax formed to the shape of an artificial eye, and moistened with oil of almonds; but this precaution also will be unnecessary, if we frequently open the eyelids, and take care to prevent adhesive inflammation by fomentations of tepid water with acetate of lead, or by ablutions of cold water. The use of the unguent. plumbi et zinci may afterwards be required, should suppurative inflammation supervene.

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ANKYLOGLOSSUM: (from *ἀγκύλη*, 'band,' and *γλῶσσα*, 'the tongue;') Any abnormal adhesion, whether congenital or accidental, of the tongue with the adjacent parts. From this definition, it is obvious that there are various degrees of this affection, all interfering more or less, according to their extent, with the proper functions of the tongue, in sucking, talking, or swallowing. A very common form of the *tongue-tie* consists in a prolongation of the frenum from the base to the tip of the tongue, while its extent from below upwards is too short to allow the tongue to be carried forwards.

The *tongue-tie* is assumed by mothers and nurses to be of frequent occurrence; such, however, is not the case. Whenever there is ground to suspect that this malformation exists in new-born children, it will be proper to institute a careful examination; and this will be best done by closing the nostrils, and forcing the child to open the mouth and cry. If the tongue cannot ascend to the palate, as it ought to do in sucking, but remains immoveable behind the lower jaw, the impediment to the function depends on the condition of the frenum. If now the tongue be raised by the fingers or a slit spatula (an instrument long in use for this purpose) the nature of the case becomes apparent at once.

If, on introducing the finger into the child's mouth, the tongue is found to encircle it firmly like a channel, and to advance over the gums in order to exercise the act of suction, the condition of the frenum forms no obstacle to the child's sucking, and under these circumstances if the infant refuses, or is unable to hold the nipple, it will in all likelihood depend on weakness or disease in the child, or on the size or form of the nipples of the mother.

Accidental adhesions may occur in various parts of the mouth, presenting themselves in the form of bands, or membraniform expansions, in consequence of mercurial ulcers, or violent salivation, during which, from the tongue being greatly swollen, and in close contact with the surrounding parts, the formation of these adhesions to the gums and surface of the mouth is greatly facilitated. Instances have been observed, where the whole of the inferior surface of the tongue was found adherent to the corresponding surface of the mouth. These adhesions are observed to arise in the cicatrization of wounds, burns, &c.

Although in most cases this malformation can only be removed by an operation, it cannot be denied that it has too often been resorted to without the shadow of a necessity for it. Little better than a century back, the midwives were in the habit of cutting the frenum indiscriminately in all new-born-children, and in Italy and Germany, they used to allow the nail of the little finger to grow long, in order to make use of it for this little operation which had become so common as to be in some respect merely conventional. If the infant is able to suck, notwithstanding the *tongue-tie*, the operation is unnecessary; should the malformation prevent talking when the child has attained its second or third year, it will be time enough to undertake an operation for its removal.

The operation itself, at whatever period it is performed, is extremely simple. The child, after being fed, is placed in the lap of an assistant, who takes care to hold the head immoveable. The surgeon introduces the fore and middle finger of the left hand, so as to receive the frenum between them, or he uplifts the tongue with Petit's slit spatula, and receives it in the slit; a blunt pointed pair of scissors divides the frenum, in a direction not upwards towards the tongue, but downwards and slantingly, in order to avoid dividing the ranine artery. This is the chief point of importance connected with the operation. Fatal hæmorrhage has been known to follow the division of these small vessels, and the danger is the greater as the flow of blood may go on unperceived. The movements of deglutition, which the child makes to swallow the blood poured into the mouth exercise the action of a pump on the divided vessel, and the blood accumulating in the stomach, nutrition is prevented. Some surgeons employ the scissors only to nick the edge of the frenum, the rest of it tearing very easily by the mere motion of the tongue. As regards the incision itself, the rule is, to divide only the thin pellucid parts of the frenum; and if it be very short, the operation will be greatly facilitated by the assistant's pressing the integuments under the chin from below upwards.

Generally, the bleeding is very slight, and ceases spontaneously. If the ranine artery, or others of the sublingual vessels should have been wounded, recourse must be had to cold water, strong styptics, such as solution of alum, aqua Theden, to plugging, &c. The best hæmostatic, however, will be a knitting-needle heated to whiteness, as its application to the bleeding vessels will not prevent the child from sucking afterwards. It will, however, even in this case, be well to abstain from suckling the child for a few hours, lest the bleeding should be renewed. If motions of deglutition are observed during sleep, the mouth should be examined, and if any suspicion should exist of the continuance of the hæmorrhage, the examination should be renewed at short intervals.

In the grown child, or the adult, the operation is performed in the same manner, and reunion is prevented by the introduction of small linen pledgets moistened in oil, by making frequent motions of the tongue, and by washing the separated surfaces from time to time with a solution of honey of roses, &c.

Several complicated instruments were invented for dividing the frenum, by Schmitt, Petit, and Heister; but they have fallen, and very justly, into complete disuse.

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ANKYLOMELE, (obsolete), from ἀγκύλος, 'crooked,' and μήλη, 'a probe.' A curved probe employed in the times of Hippocrates and Galen, for sounding or examining wounds.

ANKYLOSIS. This term is derived from the Greek adjective ἀγκύλος, signifying crooked or bent. Another derivation has been assigned to it from the substantive ἀγκύλη, a species of javelin, or, according to Scapula, the girth by which a number of javelins was held together; but it is sufficiently evident that the former etymology is the more correct. In either case it is not less erroneous than it is common to spell the word *anchylosis*, as if its primitive contained χ instead of κ.

Ankylosis is the condition of a moveable joint in which motion, both active and passive, is impaired or destroyed. Joints not designed for motion, such as the cranial and facial sutures, or the articulations of the teeth with the maxillary bones, are not said to undergo ankylosis. Nor is a joint said to be ankylosed when passive motion can be communicated to it freely, although its voluntary motion is entirely destroyed. Those cases are therefore excluded from our consideration in which the immobility arises from paralysis, hysteria, and other causes not affecting the joint itself, or the structures immediately surrounding it; but it is of consequence to observe that, even in these cases, a real ankylosis may at length take place as a consequence of long-continued rest.

There are commonly said to be two species of ankylosis, the true and the false; of which the former (sometimes called also hard or osseous) exists when the opposed articular surfaces have become united by bone; the latter, when the impediment to motion is produced by the effusion of lymph or ligamentous tissue in or around the joint, by simple rigidity, &c. The term false ankylosis has little more than a negative meaning, for the conditions which it is employed to indicate are so various that the only information which we can derive from it is, that the bones forming the articulation are not soldered together by bony deposit.

Another distinction is drawn between universal and partial ankylosis. Ankylosis is said to be universal when all, or nearly all, the joints are affected; to be partial when the immobility is confined to one or a very few. Of the former species the examples recorded are not very numerous, and do not furnish any deduction practical or theoretical. Baron Percy placed in the Museum of the Faculty of Paris a skeleton consisting, from general ankylosis, of but one single piece of bone, and it was probably this curious specimen which Boyer described in his treatise on surgery. In the Annali Universi di Medicina (1824), an account is given of a patient who, having had gonorrhœa, was not long after his cure attacked by gout and rheumatism, which gradually extended until at length every joint had become affected and ankylosed. The joints of the vertebræ and lower jaw were last attacked. The patient lay constantly in the horizontal position, and life was sustained for some years by fluid nutriment administered through a quill. In the Lancet, (vol. i. 1831-2), a case of pure general ankylosis is detailed with considerable care. Bernard Conner (De Stupendo Ossium Coalitu) describes another case; and in the History of the Academy of Sciences (1716), there is an account of a child aged twenty-three months, which became the subject of universal ankylosis. Corresponding instances are described in various surgical works ancient and modern, but it is unnecessary to draw up an exact catalogue of them, since a combination of the whole supplies us only with the fact that such things have been. Some of the cases exemplify the effects of long-continued rest, or of arthritis; and as they exhibit nothing more than false ankylosis, are remarkable only from the unusual number of joints affected. The few instances in which all traces of joints have been obliterated by a bony junction of the pieces of the skeleton, are very curious, and, in the present state of our knowledge, inexplicable phenomena. Some analogy to this process may be found in the senile tendency to ossific deposit, and in the profusion of exostoses which sometimes affect weakly children.

Universal ankylosis is a rare occurrence, but its opposite, partial or particular ankylosis, is very frequent. The term partial is employed when the ankylosis is confined to one or a few joints without affecting the skeleton generally; and the remainder of our article must be devoted to this form of the affection, which is so commonly met with; that the phrase, "stiff-joint," is familiar as a household word.

Before treating of ankylosis as it affects the more perfect articulations, those which are endowed with a synovial membrane, it will be convenient to say what little can be said concerning ankylosis of the fibro-cartilaginous joints. In these joints the motion is very limited, and the transition from the normal to the ankylosed condition is easy. The ankylosis is always effected by a deposit of bone, and the new bone is usually of a more dense and compact texture than the old. The conversion of fibro-cartilage into bone seems to be one of the changes incidental to old age, for we rarely examine the body of an old person, especially if his life have been laborious, without finding exemplifications of it in some of the vertebral or pelvic articulations. Thus bony ankylosis of the coccygeal joints often begins to take place in women after the cessation of the menses. In the spinal column this senile change is frequently accompanied by the formation of exostoses, which project from the space formerly occupied by intervertebral substance, and are sometimes of considerable size. They are more common on the anterior surface of the spinal column than on the posterior, but are occasionally met with in the latter situation, where they give rise to an incurable paraplegia, by exerting pressure on the nervous centre.

When ankylosis of the vertebral or pelvic joints takes place before the middle term of life, it is commonly the sequel of an ulcerative process in the fibro-cartilaginous tissue. This ulceration may have been primary. I have seen two vertebræ completely separated by ulceration of the inter-vertebral substance, while the bones presented only slight traces of inflammation. More commonly, however, the bone is the tissue primarily affected, and the ulceration of the fibro-cartilage is secondary to caries of vertebræ. In this state ankylosis is the only cure, and its formation ought to be promoted by enjoining perfect rest. When this caries affects the spinal column it usually happens, in those cases which recover, that the disease does not affect the whole body of the vertebræ, but is limited to the anterior part, or to one of the sides. Hence a curve is formed by the giving way of the affected side. I have seen an anterior curve produced in this way so extreme that the front part of the body of one vertebra rested upon the front parts of the body of the vertebra next but one below it. It is a curious and beautiful provision of Nature that when this curvature is formed, a quantity of dense bony matter is thrown out during the formation of the ankylosis in the hollow of the curve, so as to give support to the column. On the side opposite to that which has become ankylosed the intervertebral substance is stretched and elongated. Ankylosis of the pelvic joints is not often seen as a consequence of disease, but it sometimes follows the suppuration of the pubic symphysis of which writers on midwifery have given a description.

Ankylosis of the diarthrodial articulations, to which our attention must now be given, is so extensive and complicated a subject that those who have given attention to it, especially if conversant with surgical pathology, feel little surprise at the confused and obscure manner in which it is discussed, even in our most approved surgical treatises. Ankylosis is in some instances a disease against which we are called upon to combat, while in others, it is a happy result which we are not less called upon to promote. From this circumstance considerable perplexity has arisen. Again, the accidents which may in the sequel occasion ankylosis are very numerous and varied, and much confusion has been created by the practice of describing all these varied causes to be productive of one common effect. It is, indeed, true, that in all cases the joint is stiff, but it will be speedily seen that very different structural changes may occasion that stiffness. On the other hand, it would be a tedious labour to describe as many varieties of ankylosis as there are diseases which may remotely originate this affection. The subject will perhaps be freed from some confusion if we confine ourselves to enumerating the proximate or immediate causes of ankylosis; that is to say, the structural changes on which it depends. A constant reference to tissue will give us a very clear principle of arrangement, and with the view of still further facilitating the inquiry, I shall venture to adopt a division not in common use.

I propose to separate those cases of ankylosis which depend on lesion of tissues surrounding the joint from those which are the result of disease in the tissues proper to the joint itself. The advantages which will be gained by employing this line of demarcation are sufficient to warrant its introduction. In the first class will be included the large majority of the cases in which ankylosis is curable; in cases of the second class a cure is very uncommon. Again, in the first class of cases, ankylosis is generally a result to be guarded against, while in the second class it is too often a desirable consummation of a disease otherwise more fatal. The cases of the first class are invariably false ankyloses; those of the second may be either false or true. It is readily granted that these two classes not unfrequently run into one another; that, for example, synovial inflammation may occasion thickening of tissues external to the joint; but there are no arbitrary classifications to which the same objection is not applicable, and in this case the advantages of making the distinction are sufficiently obvious.

We proceed therefore to consider,

A. *Ankylosis, the result of lesion of tissues surrounding the joint.*

This species, which may be termed, for brevity, external ankylosis, results from a great variety of morbid states. Long continued rest is alone sufficient to produce it. A joint is preserved in its healthy state by exercise. When that is withheld the synovial secretion diminishes, the ligaments and tendons become stiffened, the muscles are rigid and contracted. Petit, and others who adopted his opinions, thought that the stiffness consequent on long repose arises from an accumulation of synovia in the joint, and a thickened state of the fluid; but a more inquiring pathology has taught that joints in this state contain a diminished quantity of synovia, and that not at all thickened. Ankylosis from this cause is very commonly seen after fractures; but if the fracture have taken place in the neighbourhood of the articulation, inflammatory deposit has assisted in producing the rigidity. Perhaps the purest example of ankylosis from rest is seen in those Indian fakirs, who, from religious motives, confine themselves for long periods of time to one position. These men have usually several immoveable joints.

Diseases of *cellular membrane* are a prolific source of external ankylosis. A slight wound, an ulcer, inflammation of veins or absorbents, the presence of an abscess, and various other causes may awaken an inflammation in the cellular tissue, which proceeds with varying degrees of rapidity to the effusion of lymph, and until this is absorbed the motions of the joint are greatly limited. It not unfrequently happens that this inflammation, when it occurs in the neighbourhood of a ginglymoid joint affects only one side of the articulation, which is usually that most abundantly supplied with cellular tissue, as the fore part of the elbow or the back part of the knee. In this case, motion is limited only in one direction, while in the opposite it can be performed almost or quite to the accustomed extent.

The following is an interesting example of external ankylosis dependent on inflammation of cellular membrane. In the middle of January, 1837, I was consulted by a gentleman who stated that in the latter end of the preceding November he had been bitten in the left ham by a dog. The wound was slight, and healed without much difficulty, but a hardness remained which had been gradually extending ever since, and had latterly been accompanied by an inability to move the knee freely. When I first saw him the space between the flexor tendons was extremely hard, the whole leg was swollen and tense, and pitted slightly on pressure; the back part of the thigh, almost to the nates was indurated, while the front part of the thigh and of the knee-joint remained unaffected; the leg could be flexed nearly to the natural extent, but could not be extended beyond a right angle with the thigh, and the motions of the ankle-joint were very limited. The skin of the part affected was hot, and there was some pain on pressure, or when the limb was dependent, but the general health was unaffected. The disease, in spite of the measures taken to combat it, advanced; the right limb became similarly affected, and the contraction of the left leg was the most extreme I ever saw. At length, however, the subacute inflammation of cellular membrane was subdued by position, cold applications, the steam-bath, and a gentle mercurial course; after which the induration and consequent contraction were gradually removed by passive motion, emollient applications with friction, and tight bandaging.

Lesion of *muscles and tendons* is not an unfrequent cause of external ankylosis. Thus, after thecal abscess, we frequently see one or more fingers permanently contracted and motionless. This occasionally arises from sloughing of the tendon, but more frequently from adhesions formed between the opposed surfaces of the theca, and hence arises the necessity of paying much attention to the position of the fingers during the recovery from this disease. The sloughing of tendon and muscle from the presence of abscesses, the involuntary contraction of muscular fibre, if long continued, and the rigidity of these structures consequent upon want of exercise, are other causes of ankylosis. Again, if the right balance of muscular power be overturned, a degree of ankylosis ensues. The uninjured muscle has lost its antagonist, and, meeting with no resistance, is in constant action. It becomes shorter until at length all attempts to restore the member to a proper position would be fruitless without a previous division of the contracted muscle.

If this state of things be not attended to, extreme contractions sometimes ensue, and the joint around which this disturbance has taken place becomes insusceptible both of active and passive motion, or, in other words, is ankylosed. The most familiar example of this form of disease is seen in the contraction of the fingers which follows upon paralysis of the extensor muscles. The paralysed muscles become small, shrunk, pale, and devoid of irritability, while the flexor muscles, having now no longer any antagonist force, contract themselves until the points of the fingers are buried in the palm of the hand. Some years ago Sir Charles Bell told me that he had been recently consulted by a musician labouring under paralysis of the extensor muscles of the fingers, and had contrived to prevent ankylosis by causing the patient to wear on the back of each finger a piece of watch-spring of sufficient power to keep the finger straight when no effort was made to flex it, but not strong enough to resist the voluntary action of the flexors. The pieces of watch-spring were fastened at one extremity into a bracelet around the wrist, and at the other, into a light ring, worn on the last joint of the finger. This ingenious contrivance, Sir Charles assured me, was so successful that his patient was enabled to resume his occupation, and to play on the piano.

Contractions of *fascia* are not uncommon causes of external ankylosis. These contractions have been assigned to the power which aponeurotic fibres undoubtedly possess of adapting themselves to changes of form and volume, in the parts in which they occur; but it is indisputable that these contractions occur frequently where no such change in form or volume has been perceptible. Laceration of fascia, or long continued rest, may give rise to this contraction; and from the analogy of other structures, it may not be unfair to infer, in our ignorance of the morbid states of this and other tissues of low organization, that fascia is subject to inflammation which produces some rigidity and shortening. Dupuytren has made familiar the ankylosis of the fingers dependent on contraction of the palmar fascia, and recently professor Fröriep of Berlin, (Preussische Medinische Zeitung, quoted in Brit. and For. Med. Rev. No. vi.) has pointed out, that ankylosis of the knee-joint sometimes depends on a similar cause, the contraction of the fascia lata, and of the prolongations which it sends off to the knee-joint. Dr. F. thinks that this contraction is most frequently produced by a carious ulcer on the back of the foot, or upon the anterior aspect of the leg. He ascribes the rigidity of the fascia to long-continued rest, with the knee in a bent position; but it is difficult to understand how such ulcers as those of which he speaks should occasion flexion of the knee, unless they excited absorbent inflammation.

The *skin* may give rise to external ankylosis. When extensive sloughing of this tissue has taken place from any cause, as a burn or bruise, the cicatrix which ensues undergoes a contraction which is unhappily very familiar to all. Every surgeon has seen the arm rendered almost useless by ankylosis of the elbow-joint consequent upon the contraction of a cicatrix.

Exostoses, aneurisms, and tumours, situated in the neighbourhood of articulations, also produce external ankylosis by an action which is too mechanical and obvious to require explanation.

We have thus briefly pointed out the chief proximate causes of the malady under consideration arranged, as closely as possible, under the head of tissue. It would be a task equally tedious and useless to recount the more remote causes. Whatsoever cause destroys the extensibility and easy play of the cellular membrane might be enumerated as a remote cause of ankylosis; but it is manifest that to make such an enumeration here would be to overstep the proper boundaries of this article.

B. *Ankylosis dependent on lesion of tissues proper to the joint.*

This species may be termed, to contradistinguish it from the preceding, internal ankylosis. It comprehends instances of both false and true ankylosis; but all the examples of the latter class are included under it. In a large proportion of cases it is not a malady which the surgeon can be called on to cure, but a result at which he is happy to arrive. The diseases which occasion it are less numerous than those which give rise to external ankylosis, but far more serious, and will be classified most advantageously under the several tissues belonging to the joint.

The *ligaments* may, in several ways, destroy or impair the motions of joints. Inflammation may be set up in ligamentous tissue by a sprain, a luxation, or a fracture bordering on the articulation, by gout and rheumatism. This inflammation gives rise, at first, to a swollen and softened state of the ligaments, produced by the deposition of lymph between the fibres; subsequently the whole tissue becomes rigid and indurated. When in this state, it has very much the character of cartilage, or fibro-cartilage, and no longer permits the bones to move upon one another with ease and freedom. The dissection of a joint ankylosed by rheumatism illustrates this condition of ligament. Inflammation may be propagated to the ligaments from disease of other articular tissues, and the same process of rigidity and hardening will ensue, but in most of these cases, the impliability of the ligaments is not the only cause of ankylosis. Ossification of ligaments is assigned, by some writers, as a frequent cause of ankylosis, but it is certainly much rarer than is commonly supposed. It is true that the cotyloid ligament of the acetabulum is not unfrequently converted into bone, so as to form a rim round the margin of the articular cavity, but every anatomist is aware that this ligament is fibro-cartilaginous in structure. The most common transformation of true ligamentous tissue is into cartilage. Ossification is not often seen except in old men who have undergone much and great exertion: when it does take place, it commences at the connexion of the ligament with the periosteum.

Rigidity of ligaments may be produced by long-continued rest. It is necessary to the healthy constitution of organs, that the functions, for the performance of which they are destined, be duly discharged; and when these are not called adequately into play, the organ soon becomes incapable of performing them. Boyer has described another mode in which the ligaments may give rise to ankylosis. He held the opinion, which is to-day not altogether without supporters, that in scrofulous white swelling the bones undergo enlargement. The ligaments, he says, consequently become too short, and hence ankylosis arises. This, though incorrect as to white swelling, since the bones in that disease do not undergo enlargement, may nevertheless hold good with regard to rheumatic joints, in which it is not uncommon to see articular extremities far exceeding the natural size.

Synovial membrane.—A very large proportion of the cases of ankylosis, both external and internal, have their origin in disease of this tissue. When synovitis continues for any length of time, a degree of inflammatory action is awakened in the sub-synovial cellular tissue and adjacent structures, in consequence of which, deposit and thickening take place around the joint. " In long-continued chronic synovitis," says Mr. Wickham, " a deposit is often observed into the ligamentous tissue which invests the capsule, and into the cellular membrane which surrounds the joint, thus giving a degree of firmness and elasticity to the tumour." In addition to this, the flexor muscles undergo that remarkable contraction which is witnessed in almost all joint diseases. This thickening and contraction frequently continue long after the synovial inflammation has ceased, and greatly impair the freedom and extent of motion. Internal ankylosis is sometimes produced by the formation of adhesions between the opposed surfaces of the synovial membrane. It is certain that the inflammation of this tissue does not ordinarily give rise to the effusion of plastic matter; but that it may do so occasionally is a well established fact. Baron Boyer unhesitatingly assigns it as one of the modes in which ankylosis is produced, and cites from Job à Meck'ren, as being probably of this sort, a case in which a stiff joint rapidly became pliable, after being violently straightened by a fall, though previously it had resisted every method of treatment. Dupuytren describes the synovial membrane of a joint which had been implicated in a fracture as red, and exhibiting long membranous bands of adhesion stretching across the articular cavity. Sir Benjamin Brodie states, that he has seen adhesions to each other of the reflected folds of the membrane; and Mr. Mayo describes very clearly cases of ankylosis dependent on such adhesions. I have more than once seen bands of false membrane connecting opposed synovial surfaces. In one beautiful specimen, deposited in the museum of Guy's Hospital, a thick bridle of cellular membrane of some length, stretches from the cartilaginous surface of the patella to one of the condyles of the femur; and in another specimen, deposited in the same rich storehouse of pathological facts, a very dense and close ankylosis has been formed by adhesions between the synovial surfaces covering cartilage.

Fig. 102.

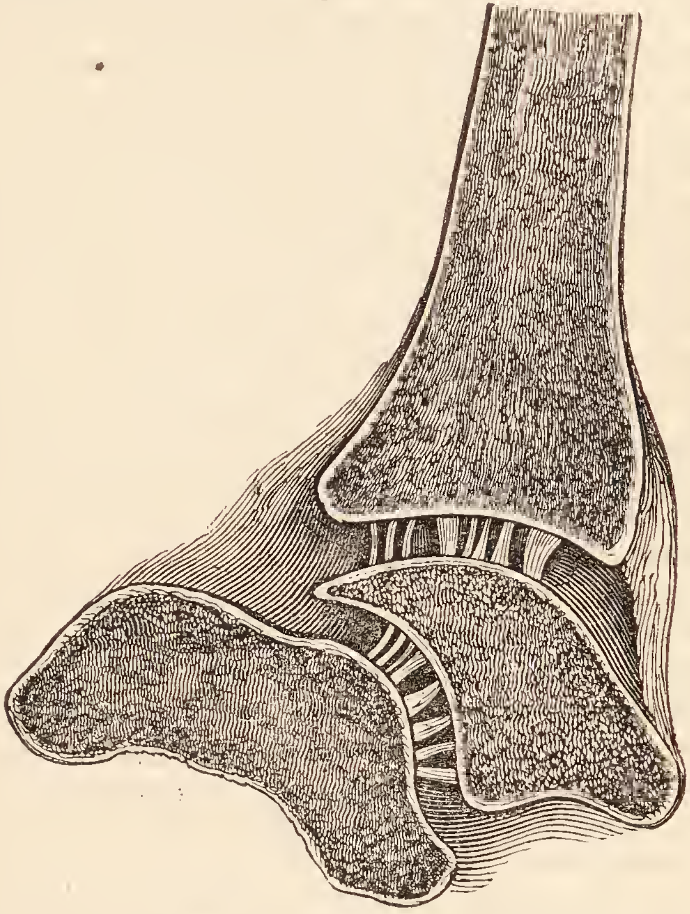

Fig. 102. *Ankylosis of the tibia, astragalus, and os calcis. From the pathological collection of Mr. Jordan of Manchester. The specimen is curious, from the great regularity of the adventitious membranous bands, connecting these bones with each other.*

The ankylosis thus formed may be very firm and unyielding, but the medium of union between the articular extremities is only cellular membrane more or less condensed, while the ankylosis which ensues after ulceration of cartilage or bone, is usually effected either by bone or by ligamentous tissue. A wound of the synovial membrane, if not fatal, very frequently gives rise to ankylosis. Sir Astley Cooper, in describing the consequences of compound fracture into a joint, and of compound dislocation, says, " The bone inflames, the cartilage becomes ulcerated, numerous abscesses are formed in different parts of the joint, and at length granulations spring from the extremities of bone deprived of their cartilages, and fill up the cavity; generally, these granulations become ossified, and ankylosis succeeds; but sometimes they remain of softer texture, and some degree of motion in the joint is gradually regained." (Sir A. Cooper on Dislocations and fractures.) In this case the synovitis, in an indirect way, gives rise to ankylosis, by propagating disease to the other articular tissues; and the same results frequently follow a synovitis which is not traumatic. The cartilage, from its contiguity to an inflamed tissue, ulcerates, the bone is exposed, and ankylosis is often the happiest termination for which we can venture to hope.

Cartilage.—Ulceration of this tissue is a disease with which we are, as yet, very little acquainted, though the admirable researches of Sir Benjamin Brodie have satisfied the majority of English surgeons of its existence, and not unfrequent occurrence. It is probable that the ulceration may sometimes cease, either spontaneously or through the remedial measures of art, before the cartilage has been extensively removed, and that the joint may be restored to its natural condition, but in many cases, the destructive process is carried on until the bone is denuded. Here, again, ankylosis is a desirable termination. If the patient be of good constitution, the inflammation excited in the bone by the ulceration of the cartilage, may be very slight and transient; in which case, lymph will be rapidly effused from the exposed surface, and adhesions will be formed which sometimes undergo ossification; but more generally assume, in process of time, a ligamentous character. In other cases, where the patient is of a less happy temperament, the bone becomes decidedly diseased; the matter effused from it is either non-plastic, or is prevented from forming adhesions, by the presence of purulent fluid in the cavity of the joint, and the denuded surfaces may be felt to grate on one another. If amputation be resorted to, the joint is found full of a sanious fluid, and the articular surfaces are dark and bare, or covered with soft, tender granulations, but no attempt at ankylosis has been instituted. Mr. Mayo speaks of ankylosis being produced by an effusion of false membrane, from the substance of the cartilage, after an ulceration which had affected only its surface. This is an appearance which I have never seen, nor do I believe it to be of common occurrence. I am well satisfied, that in nine-tenths of the cases of ankylosis following ulceration of cartilage, the bands of adhesion by which the ankylosis is effected, have been effused from the surface of the denuded bone.

Bone.—This structure may be either primarily or secondarily involved in joint diseases. It may be but slightly inflamed from sympathy in the inflammation of a neighbouring tissue, or it may be in a state of idiopathic and most obstinate caries. In either of these cases ankylosis may be the consequence. If the bone be merely inflamed, this result will be attained in the way which has already been described—by the effusion of plastic lymph from its surface, after the removal of the cartilage, and the adhesions which are formed with similar effusion from the opposed articular surface. When the bone, however, is in a state of caries, whether idiopathic or acquired, it too frequently happens that all the efforts of nature and art combined, are incapable of arresting the destructive process, and the patient sinks, or submits to amputation, without any attempt at ankylosis having commenced. If, however, the patient's constitution be of sufficient strength to bear him through the struggle, or, to use the favourite phrase of our neighbours, "si la nature, secondée convenablement par l'art," arrests the disease, the portions of ulcerating and softened bone are thrown off by granulations which spring up from beneath, the whole cavity of the joint becomes lined by these vascular and fleshy formations which inosculate with one another, and an intimate adhesion is formed between the articular surfaces. In process of time these adhesions, like all newly formed parts become pale from a diminution of their vascularity, and put on the character of ligamentous tissue, or are converted into bone by the deposit of phosphate of lime.

Fig. 103.

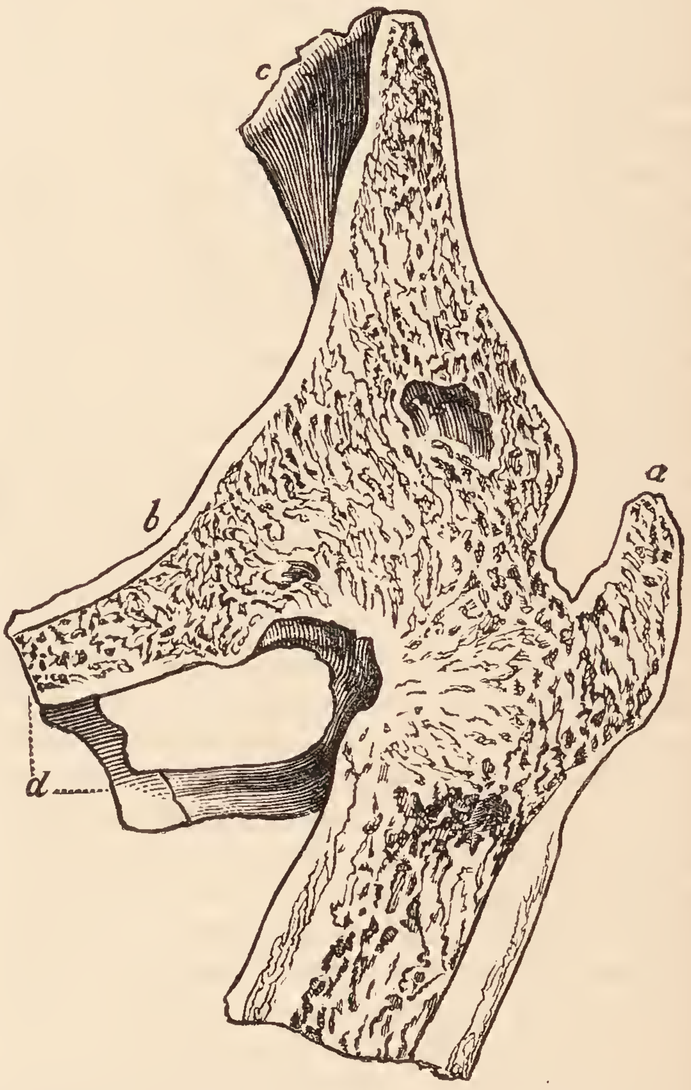

Fig. 103. *Complete ankylosis of the hip-joint, from a patient of Mr. Briant of Kennington. The joint had been stiff thirty years. The man was a horse-keeper at the Horns' Tavern, and died of phthisis at* 35. *a, trochanter major; b, head of the femur, eburnated partly at its neck, and forming one mass of cancelli with the body of the pubis and ischium; c, internal and sawed surface of the ilium; d, portion of the pubis. From Mr. B. Cooper.*

We have here given under an arrangement which seems to us better adapted than any other for comprehension and retention, a general outline of the modes in which ankylosis may be produced, and we have included under their appropriate heads, the anatomical characters of different species of the affection. A few remarks on the conditions which determine the formation of true in preference to false ankylosis will close this part of the subject. It is incorrect to suppose, that osseous ankylosis is a very common occurrence, even after the most severe and protracted diseases of joints. Crowther, whose experience was very considerable, says, "I have seen but two cases of the knee, and one of the elbow, ankylosed by ossific union," and so far as my own observation extends the inference to be drawn from his testimony is confirmed. The fallacy has probably arisen, partly from the inspection of pathological museums, for which the specimens of osseous ankylosis are treasured up, while those of ligamentous union are often thrown away, and partly from a common, though erroneous belief, that soft ankylosis always admits of some degree of motion. Nor is it correct to suppose, that, where the union has been at first ligamentous, it necessarily becomes, in process of time, bony, by the infiltration of earthy particles. Some years ago, I dissected a knee-joint which had been perfectly motionless for thirty years, and was surprised to find a very dense layer of ligament, and not bone, connecting the articular extremities. Perfect rest, and a proximity of the surfaces of diseased bone, are, probably, conditions essential to the formation of true ankylosis. Hence, in proportion to the number of recoveries from ulcerative disease of the hip-joint, as compared with the number of recoveries from similar disease in the knee-joint, true ankylosis is more frequent in the former articulation than in the latter. I am also inclined to believe, that true ankylosis more frequently follows caries of the articular extremities, than simple inflammation of bone, or ulceration of cartilage. This opinion is founded on the extraordinary tendency to the irregular and profuse deposit of bone which accompanies the recovery from caries. The new deposit is distinguishable from the original formation by its greater density and hardness, and is often thrown into miniature spires and projections which create an appearance, on a small scale, scarcely less beautiful than that of finely carved wood-work. I have in my possession a tibia of this description which is absolutely ornamented by the delicacy and varied form of the new incrustation. After caries of the vertebræ, considerable masses of bone are frequently formed, which arch over from one vertebra to another, and establish what Cruveilhier calls ankylosis by invagination. When true ankylosis has taken place, the bones are united into one piece—that is to say, there is no line of demarcation between them, and their areoles communicate.

The liability of particular classes of joints to ankylosis is a subject on which no very decided opinion can be given. Surgical writers have generally agreed in saying, that the ginglymoid joints are more liable to ankylose than the orbicular, from the size and figure of the articular surfaces, and the number of ligaments and tendons surrounding the articulations. If it be meant by this to intimate, that the diseases which give rise to ankylosis more frequently affect ginglymoid than orbicular joints—as, *e. g.* that the knee is more frequently diseased than the hip, and the elbow, than the shoulder: the assertion is correct; but this by no means settles the only interesting point in the inquiry, viz. whether there is any thing in the form or office of one class of joints to dispose them to ankylose more readily than the other, when the same causes are operating on both. We shall not however err in affirming, that the joints, such as those of the carpal and tarsal bones, which do not enjoy much motion, are, in proportion, more liable to ankylosis than others.

The liability of particular joints is a subject which does not require much observation. As a general rule, it may be said that we have only to ascertain the degree of a joint's liability to disease, in order to determine the degree of its liability to ankylosis. Some exception, however, must be made to this. Disease of the hip-joint is very common, but ankylosis of that joint is sufficiently rare. To account for this it must be borne in mind, that patients rarely have strength to carry them through the morbus coxarius, if it has been allowed to advance to that stage in which ankylosis is the only cure. A stiff elbow is therefore more common than a stiff hip, because disease of the hip is more frequently mortal than disease of the elbow. This modifying circumstance being taken into consideration, it may be affirmed that, in proportion to the frequency of their diseases, the small joints are more liable to ankylosis than the large, because the affections of the latter are often mortal. Of all the joints, those which most rarely undergo ankylosis are those of the atlas to the dentata, and the inferior maxilla to the temporal bone, and it is remarkable that immobility of these articulations would be far more serious than of any other. A patient was admitted some years ago into Guy's Hospital who presented specimens of both these phenomena. They had gradually come on after exposure to cold, and had been accompanied by rheumatic pains. He suffered great agony in attempting to bend the head, and could take only small quantities of liquid nourishment. He died in the hospital, and the two joints may be seen in its museum. In the same museum, there is another specimen of ankylosis between the atlas and dentata; and in this case, the atlas is joined by bony union to the occiput. Eustachius has described a case of ankylosed lower jaw; and another came under the notice of Cruveilhier, in which the affection had come on during the patient's childhood. She lived, nevertheless, to be an old woman, could speak very clearly, and was able to masticate food by pressing it with the tongue against the sides and edges of the teeth. Ankylosis of the atlas to the occiput is a less uncommon and less serious occurrence. I have seen several specimens of it, one of which was supposed to have been congenital.

The *symptoms* of ankylosis have been almost sufficiently enumerated when it has been described as an insusceptibility of motion, both active and passive. It would be a blunder to describe as symptoms of the affection, those conditions which tend to produce it; for, to quote Boyer, "les maladies qui produisent l'ankylose ne sont pas l'ankylose elle-même." A crooked and bent condition of the limb is so common an accompaniment of a stiff joint, though not a necessary one, as to have given origin to the name of the disease. The muscles belonging to the affected joint are, if the immobility be complete or nearly so, shrunk and wasted from long disuse. The bones also, in old cases, have become diminished in size. In a case which I have already mentioned, where ankylosis, very complete, though not osseous, had existed for thirty years before the limb was amputated; the femur, now in my possession, does not measure more in diameter than the second finger of a moderate sized hand, and the fibula is about the size of the stem of a tobacco-pipe. It is right to mention, that the ankylosis had taken place in early boyhood, so that, in all probability, the bones had not so much diminished, as they had ceased to grow. When amputation was performed, the patient was a man of middle size, and the other parts of the skeleton had their ordinary development. When the ankylosis is osseous, especially if it be seated in the central joints of the limbs—to wit, the knee and elbow-joints—the patient will be liable to unpleasant jars from any violent shock at the extremity of the limb, and will also be in considerable danger of fracture from comparatively slight causes.

Fig. 104.

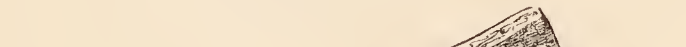

Fig 104. *Ankylosis of the knee-joint—left limb. a, the patella; d, the tibia; e, osseous union of these two bones. This and the preceding figure were sketched by permission, from preparations presented by Mr. B. Cooper to Guy's Hospital Museum.*

The *diagnosis* of ankylosis presents little difficulty as there is only one affection with which it is liable to be confounded. In the early stages of the acute affections of joints, the pain is often so severe and becomes so intensely aggravated by motion, that the limb is maintained in most perfect quiet by the patient himself, and the whole muscular power is put into play to resist any attempt made by the surgeon to move it. Thus, in acute synovial inflammation, or ulcerating cartilage of the hip-joint, the muscles are sometimes so perfectly rigid during the examination, that the body of the patient may be raised by the thigh without producing any motion in the hip; and Sanson states, (Dict. de Médecine et Chirurgie Pratique, Art. Ankylose), that he has known an eminent surgeon pronounce a very simple case of arthritis to be one of ankylosis from this circumstance. In order to determine, where there is any doubt in these cases, the surgeon should allow the joint rest for a short time, should engage the attention of the patient on other subjects, and should then endeavour to ascertain, but always by gentle movements, what is the true state of the articulation. By proceeding in this manner, with caution and patience, he may in all cases arrive at a very certain conclusion. But if the diagnosis of ankylosis from other affections be easy, that of the different species of ankylosis is proportionably difficult. It is often next to impossible to decide whether an ankylosis be true or false, for, as every practitioner must have learned by experience, the immobility may be quite as great in one case as in the other. The most valuable diagnostic sign with which I am acquainted is this: when the union is osseous, very strenuous efforts may be made to give motion to the affected joint, without producing any pain, or even the fear of pain; while an opposite result is common if the union be not osseous. It is also said, that the joint remains more swollen when the ankylosis is soft, but I am not able to speak of this positively. The sensations of the patient may afford us some little assistance. If he feels an unusual jarring and vibration of the limb on slight occasions, if he is very careful in the use of it, to avoid little shocks and concussions, it may be inferred that the bones have become cemented together. Another slight indication may be mentioned. If the ankylosis be soft, we shall find, in examining the limb, that when considerable efforts are made to bend it, the muscles which resist motion in the direction intended are called into exercise and become rigid; if the ankylosis be bony, they will remain wholly unconcerned. These are slight indications; but they are all with which I am acquainted, and fortunately the question is not of much practical importance. The diagnosis between the different species of false ankylosis, must, in general, depend on the previous history, which will often enable us to arrive at a very satisfactory conclusion. Thus, if there have been ulceration of cartilage and disease of bone, it may be concluded that the union is by means of ligamentous fibres; if synovial inflammation, without injury of cartilage, there may be cellulo-membranous adhesions between the opposed surfaces of the synovial membrane, or more probably the membrane itself is thickened and stiff, the ligaments have lost some of their extensibility, and deposit has taken place in the tissues around the joint. The only difficulty which can arise in diagnosticating between external and internal ankylosis, is in those cases of cellular inflammation, pointed out with great perspicuity by Mr. Wickham, in his work on articular disease, as being liable to be mistaken for affections of the joints. In all other cases, a short inquiry into the patient's previous history will enable us to decide, not only whether the ankylosis be internal or external, but also, if it be external, what has been the primary lesion; whence it will not be difficult to infer the present impediment to motion.

Fig. 105.

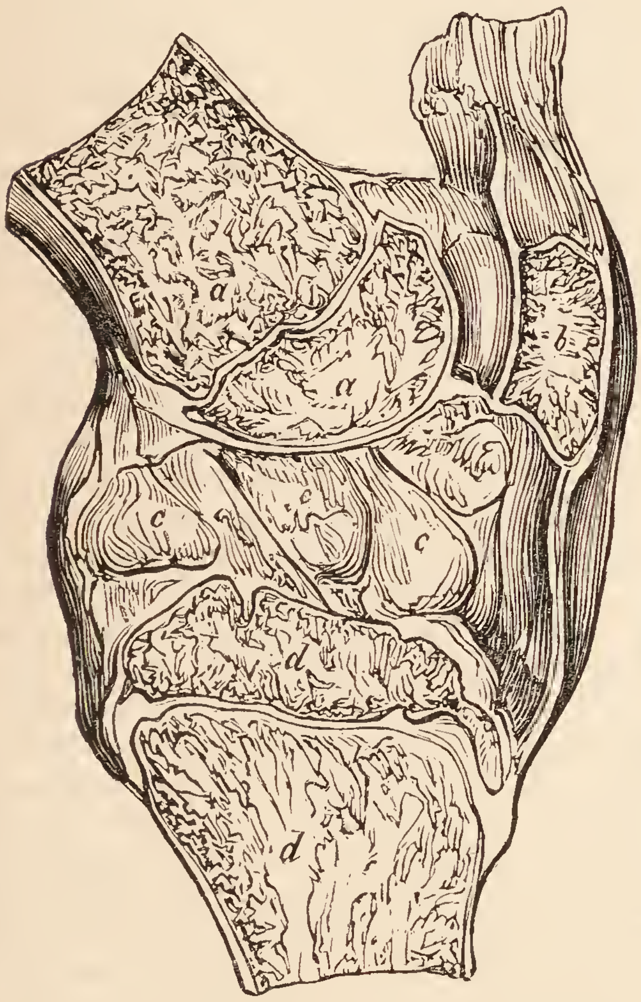

Fig. 105. *Section of a knee-joint united by soft union. This sketch was taken by permission from the preparation, No. 239 (one of Hunter's), in the Museum of the Royal College of Surgeons. a a, the femur with its epiphysis; b, the patella; c c c, soft uniting substance; d d, the tibia with its epiphysis.*

The *prognosis* in the affection under consideration can have reference to life only when the inferior maxilla has become subject to it. I have read of one case in which the patient, labouring under this disease, sunk from want of nourishment; but we have already seen in the case cited from Cruveilhier, that this is not an inevitable consequence, and other instances might be adduced, if necessary. Indeed, if the front teeth be extracted, as they unquestionably may be, even when the mouth is firmly shut, it is not easy to conceive how there can be any difficulty in administering a sufficient quantity of soft and pulpy nourishment, not merely to support life, but to support it in considerable vigour. Even in this case, therefore, the prognosis may be favourable, and in every other, life is in no danger. An opinion may, however, be wanted as to the probability of the joint's recovering its proper functions. Where the ankylosis is external, we may usually promise a restoration in process of time, if the affection be not of very ancient date, and do not depend on the sloughing of tendon or muscle. If the ankylosis be internal, we may, in an early stage of the affection, anticipate recovery, if the primary malady has been simple synovitis without ulceration of cartilage, or has been confined mainly to the ligamentous tissue, as in gout and rheumatism; but, where the cartilage has ulcerated, and the bone has been inflamed or carious, no cure can be expected by the application of any ordinary means, for ankylosis is itself the cure. In all cases, the probability of cure depends, in some degree, on the age of the patient, for as life advances the tissues become more rigid; and in a much higher degree on the length of time that the ankylosis has been established. A cure is also effected more easily in orbicular than in ginglymoid joints.

The *treatment* of ankylosis is the last and most important point which claims our attention. From what has been already said, it is sufficiently obvious that no one plan of treatment can be laid down which shall be applicable to all cases of this affection. And additional difficulty invests the subject, from the circumstance, that it is sometimes our business to promote, by every means in our power, the formation of ankylosis, while at others we are not less strenuously called upon to remove it when already formed. The former class of cases will fall first under consideration.

Curative ankylosis is a term which may be employed to denote those cases in which we seek to aid the formation of ankylosis—not to prevent it. Under these circumstances, ankylosis is reparative, or as it has been elsewhere termed, it is "an effort of nature to remedy the effects of disease." When a process of ulceration has been going on within the interior of a joint, a disorganization is effected which makes it impossible that this complex machine should ever again perform its proper functions; and not only is the joint injured, but even the life of the patient is threatened. Under these circumstances, ankylosis is the only favourable result, and it becomes the duty of the surgeon to promote it in every possible way. The joint should be kept in a state of complete repose. To insure this repose it has been recommended to case the limb in plaster of Paris, but this bricklayer work is often not practicable, and seldom necessary, since the patient is usually unable to accomplish the least motion of the joint. If the remedies employed to subdue the disease prove successful, the reparative action will commence, and the object of the surgeon will then be to procure such a position of the limb as shall render it most useful when the recovery has been perfected. Thus, if ankylosis is about to take place in the elbow, or any of the finger-joints, the finger or arm should be kept in a state of semiflexion. If the knee be threatened, it ought, if possible, to have slight flexion : it should not be quite straight, because, when one knee is stiff, it is an advantage in walking to have some shortening of the affected limb. Beyond attention to these points, the surgeon has nothing more to do than to watch the slow process by which the limb is restored to all the usefulness of which it is now capable.

It is fortunate that we have more agents at our command to prevent or to remove ankylosis than to promote it. In treating what may be termed, to distinguish it from the preceding variety, *curable ankylosis*, our first object must be to ascertain the original lesion of which we are attempting to remove the result. If this be effected, it will not be difficult to discover suitable methods of treatment, some of which belong so entirely to other branches of surgery, that it is unnecessary to do more than indicate them here. Thus, where a contraction of the skin after a burn or an ulcer is the immediate cause, the cicatrix ought to be divided. Where the joint is rendered motionless by an exostosis, the new formation ought to be removed, if its removal can be effected with safety to the articular cavity. Where an aneurism has induced ankylosis the artery should be tied at the proper place ; where a tumour impedes the movements of the joints, it ought, if practicable, to be extirpated. Should any stiffness continue after the adoption of these measures, the method of treatment indicated below for rigidity of synovial membrane, ligament, &c., will be applicable and rarely unsuccessful.

When a *contraction of fascia* is the cause of the ankylosis, Baron Dupuytren has shown that the knife may be used with advantage for the division of the restraining bridle. In the ankylosis of the knee-joint, dependent on contraction of the fascia, and the prolongations which it sends to the knee-joint, Professor Froriep condemns the resort to a similar operation, and trusts for a cure to extension. It is to be feared, however, that extension alone will be always a tedious and often an unsuccessful method ; nor do these appear to be any very strong objections to the use of the knife. The operation would, in all probability, be free from danger ; its difficulty, to a competent anatomist, would not be great, and the success with which the corresponding operation has been performed on the finger leads to the anticipation of a happy result. In the after-treatment of such a case, care must be taken to keep the limb as much extended as possible, to commence passive motion at an early period, and to watch the patient for some time after his recovery. It is not necessary, however, to employ violent extension, or to commence passive motion immediately after the operation. The divided ends of the fascia will probably reunite, but the connecting medium will for some time be soft and easily extensible, so as to admit of the limb being restored, by gentle but steady measures, to its natural shape and mobility.

Where the ankylosis has resulted from *lesion of muscle or tendon*, a cure is not often attainable. It is of course impossible to restore a muscle or tendon which has sloughed away, and it is often almost as impossible to remove the paralysis which has paved the way for ankylosis. In this latter case, however, when the paralysis is recent, a successful effort may be made to prevent the supervention of the affection by substituting for the destroyed muscular force, a permanently acting mechanical power, in the manner described in the case of Sir Charles Bell, already detailed. When ankylosis is threatened, as a consequence of thecal abscess, it has been recommended to commence motion, either active or passive, at an early period after the evacuation of the matter, and thus to break up the adhesions which are in process of formation between the free surfaces of the theca. The recommendation is more easy to give than safe to act upon. The theca of a tendon is in fact a synovial membrane, and shares in the proneness of that tissue to inflammatory action. The commencement, therefore, of motion at an early period after thecal abscess, is a short and efficacious method for the renewal of the painful malady from which the patient was beginning to escape. " Haud inexpertus loquor." Some time ago, having seen, in rapid succession, several hands which had been rendered useless by ankylosis of the fingers consequent upon thecal abscess, I was induced to recommend a man who was recovering from a very severe attack of this disease, to move his fingers about gently, and at intervals during the day. The next morning, when I visited him, I found him in great pain, his hand and arm tensely swollen, and presenting all the symptoms of a recurrence of the disease. Happily the inflammation was speedily subdued, and no material evil resulted ; but I did not again venture to provoke the irritable temper of a theca. It must not be supposed that I condemn the resort to motion after thecal abscess ; but I am very sure that it ought not to be employed for some time after the evacuation of the matter, nor until the inflammatory action has fairly subsided. It may then be prosecuted steadily, though gently, and, with the aid of measures shortly to be described as appropriate to rigid joints in general, will often succeed in restoring partially the mobility of the fingers.

Where the ankylosis has resulted from *inflammation of cellular membrane*, the first object must of course be to subdue any remaining inflammatory action. That effected, we have to promote the absorption of the deposit which has taken place, and thus to restore extensibility to the cellular membrane. To this end friction will conduce, and the use of rubefacient liniments, of which I have found the Lin. Camph. Co. to be the most useful, probably, from the mercury which forms one of its principal ingredients. The use of iodine ointment (℞ Iodin. gr. ij. Hydr. Potass. ʒi. Adipis ℥i.) has been recommended, but in the trials which I have made of it in this condition of cellular membrane, I have not found reason to concur very decidedly in the recommendation. Marked advantage frequently follows the local application of the steam-bath, a remedy so cheap and so effectual that it deserves very general use. A tea-kettle full of boiling water, kept hot by an iron heater beneath it, will keep up a sufficient supply of steam for a considerable time. Of course, the steam ought to be confined by a cloth thrown over the limb, and over the spout of the kettle. The same end may be attained by placing the kettle on a small fire, but this method is less convenient. The grand remedy, however, in these cases is pressure, which of itself is often adequate to the cure. A tightly-applied bandage, or what is still better, strips of strong adhesive plaster, firmly incasing the limb, occasion frequently a very rapid disappearance of the swelling and induration. Along with these measures, passive motion must be employed, but with all gentleness; bearing constantly in mind the danger which exists of again awakening inflammation in the cellular membrane.

When the ankylosis has followed upon sprain, luxation, long-continued rest, gout, rheumatism, simple synovitis, or any cause which would occasion rigidity of tissues, (and in this class are included the large majority of cases to which any treatment is applicable) steady perseverance in the use of very simple methods will often effect a cure. The muscles, tendons, cellular and synovial membranes, and ligaments, have lost their natural flexibility, by the restoration of which the ankylosis may be removed. We commence by the use of oleaginous fomentations, or emollient cataplasms, to which the steam-bath, or the long-continued play of a jet of warm water against the joint may be added with advantage. In France, baths are made use of to which the hydro-chlorate of soda or ammonia is added, and it is said with advantage. The joint and the limb above it, so as to include the whole course of the stiffened muscles, ought to be rubbed two or three times every day, and for half an hour at a time after the use of a fomentation, with some oily liniment.

Boyer recommends us to expose the part to the warm vapour of the entrails of sheep, oxen, &c., by thrusting the affected member into the peritoneum of newly-killed animals. The same writer advises the envelopment of the joint in the epiploon or the warm skin of a sheep. I do not deny that these measures may be useful, but they are often impracticable, and always disgusting; nor do I suppose that they possess any marked superiority. There is, however some truth in Benjamin Bell's opinion, that animal fat answers better than vegetable oil as an emollient in stiff joints.

When these measures have succeeded in relaxing a little the stiffened tissues, passive motion ought to be commenced. The patient himself must not be employed in communicating this motion, for he will rarely do it effectively; he will either deceive himself by moving the superior joint, or he will be so much afraid of producing pain that the degree of force used will be inadequate. On the other hand, none but a judicious and patient person ought to be entrusted with the office, and in all cases the surgeon ought to instruct the person who is to be regularly employed, by a practical exemplification of the method to be used. The attempts to communicate motion should always be made on the "gutta cavat lapidem" principle; that is to say, they should be gentle but persevering. Half an hour three times a day after the use of some of the remedies noticed above will be well employed in this way. The attempt should never be so forcible or so long continued as to create positive pain, though generally a slight feeling of uneasiness will be experienced from the commencing efforts. Care also ought to be taken first, that all the normal movements are communicated to the joint, and, secondly, that none other than the normal movements are communicated. In the early attempts, a sort of crepitation is often perceived which ought to afford encouragement to a steady procedure in the method of treatment, but the necessity of avoiding that degree of force which might reawaken inflammatory action cannot be too often inculcated. If these measures be successful, (and a very persevering trial of them ought to be made before abandoning them) we have the satisfaction of seeing the motions of the joint gradually increasing, and the patient should then be directed to commence a cautious use of the limb. It is by voluntary motions that the cure is generally completed.

When the ankylosis is old or very obstinate, we may resort to the use of machines, (such as the apparatus of Lafond) so constructed as constantly to exert some pressure in a right direction, and to prevent any increased contraction. Thus, when the knee-joint is flexed at a right angle, one of Mr. Amesbury's splints may be applied to the back of the joint, and the utmost degree of extension of which the knee is susceptible, without pain, steadily maintained by means of the screw. The measures above recommended, fomentations, friction, passive motion, &c., ought to be persisted in, and on every fresh application of the splint an attempt may be made to increase the extension. Sometimes, to prevent increased contraction, a side-splint may be usefully applied along the whole limb.

Various machines have been used by the

older surgeons to produce forcible extension; one of which has been pictured by Fabricius Hildanus, but many of them are too complicated to admit of general application. A simple and well-known contrivance in ankylosis of the elbow-joint, when accompanied as it usually is by flexion, consists in placing a weight in the ball of the hand, which the patient should support as long as he is able. Fabricius Hildanus says, that he frequently found this treatment successful. Where the knee-joint has been flexed and ankylosed, I have sometimes employed a similar treatment, by making a patient sit in one chair with his heel resting on another placed at a convenient distance, while a heavy weight was suspended from the knee by a broad belt passing over the front part of the joint.

We have now only to speak of the treatment of those cases of ankylosis in which the bones are united by bone or by dense ligamentous tissue. In the latter case, the connecting medium may be of sufficient length to allow of a certain degree of motion, and a good false joint is gradually formed; but this happens rarely. The bones are commonly in close apposition, the ligamentous fibres short and unyielding, and the joint altogether incapable of motion. It is sometimes loosely said, that this might have been prevented by communicating motion during the formation of this species of ankylosis: but those who draw their conclusions from practice will feel but little inclination to try so dangerous an experiment. It is true that an ankylosed limb is always awkward, and sometimes not only useless, but an incumbrance. Are we then to make no effort for the removal of this evil? Some of the French surgeons think that we ought, and have adopted a very summary method,—the ablation of the offending member, or, as it is termed, the "amputation de complaisance," to which we have in England no corresponding technicality, There is no doubt but that amputation may be performed with propriety when the joint in question is small, as, for instance, in the phalangeal articulations; but English surgeons will agree in the opinion that we have no right to endanger life for the removal of what is merely an inconvenience, and that, therefore, the amputation of a limb because of an ankylosed knee or elbow is inadmissible. Let it be added to this, that according to the testimony of Richerand, Pelletan, and Velpeau, the "amputation de complaisance" has, more frequently than amputation from other causes, a fatal termination.

Another method of treating ankylosis of the sort now under consideration has been proposed and carried into effect. I cannot better introduce it than by the following abridgement of a case which has not attracted sufficient attention in this country. A man, who had fallen from the hatchway of a ship into the hold, sustained some injury of the hip-joint, the nature of which does not exactly appear. Seven months after the accident, he sought relief from Dr. Barton of Philadelphia, who gives the following account of his condition at that period:—

"He was supported by crutches, having the thigh drawn up nearly to a right angle, with the axis of the pelvis and the knee turned inwards, and projecting over the sound thigh, so that the outside of the foot presented forward. There was considerable enlargement round the hip which so much obscured the case, even at this date, as to prevent me from forming any positive opinion as to the real nature of the original injury. From the fixed and immovable condition of the limb it was impossible to ascertain, whether in a straight position there would be shortening, and if any, to what extent. The general feature of the limb bore somewhat the resemblance of that resulting from a dislocation into the ischiatic notch, yet the position in which the great trochanter stood, in relation to the superior anterior spinous process, discouraged such a belief. All things considered, I was rather inclined to the opinion that there had been neither fracture nor luxation, but that the violence of the fall had produced an extensive contusion of the round ligament and joint, and that disorganization had followed the consequent inflammation. On this point, whatever might have been the nature of the accident, I thought I might feel assured that now all articular movement was gone, and that true ankylosis had taken place."

In this state he was admitted to the Pennsylvania Hospital, where he remained a year, during which time all ordinary methods were employed for the removal of the ankylosis, but without success. At the end of the year, Dr. Barton, finding the case hopeless, unless something extraordinary was attempted for the man's relief, proposed to make a crucial incision over the great trochanter, to divide the bone transversely through this apophysis and part of the neck, and to procure, if possible, a false joint.

"In this proposition four material points presented themselves for consideration; viz. the practicability of the operation; the degree of risk to life consequent thereto; the probability of being able to arrest ossific reunion; and the reasonable prospect of benefiting the patient thereby. The arguments I adduced in favour of such an operation were these:—That the anatomy of the part did not present any insurmountable obstacle to it. The fear of cutting into a joint was not to be entertained here, since from previous disease, all the characteristics of a joint were gone, synovial membrane destroyed, cartilages absorbed, and an amalgamation of the head of the femur with the acetabulum had taken place. That the shock to the vital system would not probably be greater than is frequently endured from accidental injuries and other operations. That if the opinion commonly assigned as the cause of the formation of false joints after fractures be true, such as frequent motion in the broken ends of the bone, a deficiency of tone in the system, &c., these agents could be resorted to with promising results."

His colleagues having given their consent to the operation, it was performed on the 22nd of November, 1826, in the following manner.

"The integuments and fascia being divided and raised, the muscles in contact with the bone, around part of the great trochanter, were carefully detached, and a passage thereby made just large enough to admit of the insinuation of my fore-fingers before and behind the bone, the tips of which now met around the lower part of the cervix of the femur, a little above its root. The saw was readily applied, and, without any difficulty, a separation of the bone was effected. The thigh was now released, and I immediately turned out the knee, extended the leg, and placed the limbs side by side, by a comparison of which, in reference to length, the unsound member betrayed a shortening of about half an inch. This might have been caused partly by a distortion of the pelvis. Not one blood-vessel required to be secured. Union by the first intention was not attempted; the lips of the wound were only supported by adhesive plaster and slight dressings. The patient was put to bed, and Dessault's splints were applied to support the limb.

"The operation, though severe, was not of long duration, it being accomplished in the space of about seven minutes.

"In the evening, the patient suffered great pain and was much prostrated; his pulse feeble, stomach irritable, with great restlessness."

From this state of collapse he rallied, and on the twentieth day after the operation passive motion was cautiously commenced. At first it was only employed at intervals of several days, but as it seemed to produce little disturbance was soon used more frequently.

"Sixty days after the operation, the patient (who had previously exerted his muscles in slightly flexing, extending, and rotating his thigh), guided by careful assistants, left his bed, and, aided by crutches, stood erect, both feet reaching the floor: he thinks he bore ten or twelve pounds' weight on the weakened limb for a few minutes; made an attempt to advance the leg, and did so exclusively, by muscular exertion, then rested on the sound side and rotated the knee, and, as he says, without pain."

On the 31st of January he walked a distance of 150 feet, with the assistance of crutches, and on examining him, "we found him able to perform flexion and extension, abduction and adduction, rotation inwards and outwards, and able to cross the opposite foot: he had then, in fact, regained every movement which the limb originally possessed." In the following month, February, the patient had an attack of erysipelas, on recovery from which he began again to take regular exercise, and to gain strength. On March 1st, it is said, "He rises in the morning and retires not until night; in the mean time amusing himself by exercise in walking, which he now begins to accomplish by the aid merely of a cane: time only seems to be required to enable him to walk without even this assistance. The following is the degree to which he can perform the movements of his limb with perfect ease: by measurement from a straight line, he can advance his foot twenty-four inches; in stepping backward, twenty-six inches; in abduction, twenty inches; in rotation inward, six inches, and outward, six inches. . . . . Upon examining for the space that usually exists between the projection of the great trochanter and the posterior margin of the acetabulum, it will be discovered that it has been filled up by an accumulation of osseous matter, apparently deposited there to prevent displacement of the bones and to form something like a socket.

"The outward contour of the hip resembles that of the sound side, except in the disfigurement occasioned by the extensive crucial incisions.

"When the legs are extended, a slight shortening of the right limb is perceivable, but not sufficient to cause him to limp in walking. The thickness of the blade of the saw taken from the length of the femur, and the subsequent change of the divided surfaces, might have caused this retraction of the limb. When the knees are drawn up, there is an increased shortening, which again disappears as they are extended. By placing the hand over the upper part of the trochanter, and moving the limb, that portion of the bone will be found perfectly at rest; but when the hand is lowered to the part where the joint has been formed, the articulation is satisfactorily felt. The sensation conveyed to the hand is not like that occasioned by two bare surfaces of bone rubbed against each other, but like that imparted by the motions in a natural and healthy joint." (Vide North American Surgical Journal, 1827, or the Lancet of September 1st, 1827.)

This extract is long but full of interest. I am not aware that any similar case is on record, but I have heard that the same operation has been repeated in America, but with a fatal result. It will be observed that Dr. Barton proceeded on the belief that he could establish a false joint by keeping up motion between the divided ends of a bone. The experiments of Chaussier, Köeler, and Sir Astley Cooper, on animals; the observation on ununited fractures made by Larrey during the campaign of Egypt, and the history of cases of excision of diseased joints, warranted this belief. The false joint is sometimes endowed with structures resembling a cartilage and synovial membrane, but more commonly it is formed by the interposition of ligamentous fibres between the ends of bone, and the motion of the new joint depends on the flexibility of this connecting medium. After excision of a joint the bones are united in this manner, and it is now sufficiently established, that after this operation the limb is often of great value, certainly of greater than if it were ankylosed. So far, therefore, the argument is in favour of Dr. Barton's proposal; but before we give it our decided approbation, the important question has to be considered, does it endanger the patient's life? If we look again to the somewhat analogous, though more severe operation of excision, we find that it has been almost invariably successful when performed in the elbow-joint, generally, on the shoulder-joint, never, on the hip, where, indeed, it has been but once attempted, and rarely on the knee. There are many reasons, which the reader will be at no loss to call to mind, why an operation such as that proposed by Dr. Barton should be more successful than the operation of excision; but I cannot bring myself to believe, that even the former can be performed on the lower extremities without considerable danger. The large size and depth of the wound must oftentimes give rise to severe irritative fever, or exhausting suppuration. These are risks which the evils of ankylosis do not warrant us in incurring; at least, I should find it difficult to wash from my hands the blood of any patient of mine who died in consequence of an operation for the relief of ankylosed hip or knee. With regard to the joints of the upper extremity, the case is altered, at least so far as the elbow is concerned. On this joint, excision is almost invariably successful, and the operation for ankylosis would be short and bloodless. It would often be sufficient to make a simple horizontal incision at one end of which the needle of the chain-saw might be introduced and brought out at the other, when a few movements of the instrument would complete the operation. At the same time there are but few combinations of circumstances which would warrant us in interfering with an ankylosis, even in the elbow-joint. We ought to be well satisfied that there is no probability of a recurrence of the disease which gave rise to the ankylosis. After scrofulous caries, or what used to be termed white swelling, there is a remarkable tendency to a relapse, so that after several attacks, and as many tedious recoveries, the patient at length succumbs under a fresh invasion, or is compelled to submit to amputation. If the ankylosis, therefore, has followed caries, an operation, unless the joint has been for many years in a quiescent state, would probably excite to growth the dormant seeds of disease. Again, if the arm be ankylosed in a convenient position, it would be unwise to interfere. The operation is, however, not only admissible, but highly desirable, when the whole limb is rendered useless by the fore-arm being permanently flexed to its full extent, so as to lie in contact with the arm, or when the whole limb is perfectly straight. On the whole, therefore, the surgeon will do well to remember that, under certain circumstances, even a densely ligamentous or osseous ankylosis is not wholly without the pale of surgical assistance.

(*John Blackburn.*)

To the above elaborate and highly practically useful article, may be added a few additional observations relative to the treatment of those ankyloses called partial, (which are as burdensome to the individuals afflicted with them, as true or bony ankylosis); namely those which depend upon organic or functional lesion of tendon or muscle, whether that be 1. from sloughing or adhesions of them, 2. from spasmodic contraction, 3. from organic contraction through paralysis of antagonists, or 4. from contraction owing to long continued rest of the limb.

We may suppose indeed that ankylosis of every kind interests, to a certain extent, all the muscles surrounding the articulation, or at least those which through having been for a long time relaxed by the position in which the joint has become fixed, have contracted themselves; and as in most situations of the body, or at any rate in those joints most prone to ankylosis, the power of the flexors exceeds that of the extensors, we find most commonly that in such incomplete ankylosis, depending partially or wholly upon contracted muscles and tendons, it is the former class of muscles which we have opposing the patient's or our attempts to restore the limb to its natural motion. Yet where the patient has reached the adult age before the occurrence of the disease in and about the articulation, which has given rise to the (partial) ankylosis, we are usually able, unless the contraction, has existed beyond ten or twenty years, to overcome whatever resistance the muscles contracted merely through rest are able to offer, by a diligent perseverance in the means enumerated in the preceding article. Even if the patient be young and the contraction of the muscles through rest have existed but a short time, we may succeed in re-elongating them in the same way; but whether the patient be an adult or youth, if we have persevered weeks, months, or years, without effecting any benefit or a cure of the contraction we have no other alternative than the division of the resisting muscles and tendons, which has been mentioned by the author of the preceding article p. 307; in cases where the balance of muscular power may have been destroyed, and the safety and extensive application of which, was first suggested and demonstrated by Stromeyer, and confirmed by the success which has attended my own practice. I have recently divided the tendons of the biceps femoris, and semi-membranosus and semi-tendinosus muscles for the relief of a partial or so-called ankylosis of the knee joint, consequent upon protracted repose of the muscles and constantly bent position during the tedious progress of disease of the joint. The case was that of a young lady aged eleven; the disease of the joint had commenced between four and five years previously, and after suppuration and caries in several situations around the articulation, had subsided two years ago, leaving the tibia partially dislocated outwards and backwards, the knee bent to the fullest extent, the patella almost immoveably fixed upon the external condyle of the femur, and the toes rotated outwards ; her favourite method of supporting the limb during the progress of the disease, having been the placing the outer side of the leg and ankle upon the opposite thigh close to the inguinal region, where she in fact had pertinaciously held it to guard it against jars, shocks, &c. The most appropriate mechanical means, aided by frictions, baths, manipulations, &c. had been resorted to by the gentlemen who had attended the case, and with considerable diminution of the contracted state of the knee-joint, as when I was first introduced to the patient the leg could be extended almost to a right angle with the thigh, at which point its further extension was arrested by the rigidly contracted flexors of the knee ; in which state the limb had obstinately remained for the last twelve months. The ankle joint was also fixed, the foot being in a straight line with the leg, owing to the more powerful posterior muscles of the leg (gastrocnemii, tibialis posticus, flexor longus pollicis, and flexor longus digitorum) having obtained the ascendancy during the long inaction of the limb, over their weaker antagonists. The muscles of the thigh were smaller than those of the opposite side, but the most notable disproportion both of hard and soft parts had occurred in the leg and foot, the tibia and fibula being shorter to the extent of between two and three inches, and the circumference of the leg being less by nearly one half, than that of the sound side. Before resorting to any other than purely mechanical means for the straightening of this limb, many important circumstances suggested themselves for consideration, embodied in the following queries entertained by me at the time.

What is the precise condition of the parts composing the joint?

Is there any alteration in the articular surfaces and ligaments which can impede the bending of the joint?

What share have the evidently contracted gastrocnemii in maintaining the ankylosis of the knee.

Is there no danger of reproducing the disease of the articulation, by performing any operation in its immediate vicinity, and by a comparatively rapid extension of the limb, disturbing the present quiet state of the ligaments? And if the operation prove successful and the knee be straightened, will the patient have a limb (shortened and wasted as are the bones and muscles of the leg,) sufficiently useful to repay her for the pain and risk of the proceeding?

The condyles of the femur were evidently enlarged and the tibia was articulated chiefly with the under and posterior part of the external condyle ; yet as by a careful examination, the leg being held for the purpose as much extended as the ankylosis would admit, it was satisfactorily ascertained that the patella was not adherent by osseous union to the femur, as a slight motion upon its transverse axis could be communicated to it, and the joint could be freely flexed still more, so as to bring the heel almost in contact with the nates ; it was highly probable that no difficulty to a greater extension of the limb was offered by the bones and ligaments, for if the latter were so lax as to admit the joint to be easily *flexed* to the full natural extent, they would, supposing that other existing obstacles were removed, for the same reason allow extension to be performed. The only ligaments about which there could be any doubt, were the lig.-post. of Winslow, and posterior crucial ; but as these must have undergone some disorganization, or even elongation in order to have admitted a partial luxation of the tibia backwards, they therefore, instead of being rendered tense, and thus opposing *extension* of the limb, would be relaxed by the curative efforts and rather facilitate its reduction. When a quick effort was made with the hand to straighten the limb, there was felt, it is true, a sudden stop to the extension, almost as if there were an osseous hitch somewhere in the joint, and I at first thought it was the patella, which by its firm connexion to the outer condyle offered the obstacle. But agreeing with the diagnostic sign laid down p. 312, the forcible attempt to straighten the limb produced pain along those muscles on the back of the thigh, which resisted motion in the direction intended ; they were called into exercise and became rigid, but when tired out, in a few seconds their organic contractibility yielded gradually to the application of the superior power of the hands up to a certain point, beyond which they were incapable of elongation. It was evident to me therefore that the shortened state of the flexor muscles constituted the chief impediment in this case, although the fasciæ and other soft parts surrounding the joint contributed their share to the contracture. To be satisfied however that the state of rest, of from only four to five years, could produce such a permanent shortening of those muscles as to render the bending of the joint impossible, whereas after adult age it is known that by perseverance similar contractions of many years' standing, inducing ankylosis, may be overcome, thus leading us to a conclusion the reverse of which we usually infer from our knowledge of the greater laxity and extensibility of the tissues in youth, we must review and compare the circumstances attendant upon the progress of such cases as respects the muscles, at different ages. Physiologists have assigned various intervals during which the various parts of the animal machine undergo a total change of their component parts ; some are of opinion that within seven years, every integrant particle of the body is removed and its place supplied by others ; this again as regards the harder and particularly the osseous tissues has been denied altogether: be the period however what it may, it is probable that any structural change, which may take place in parts rendered unserviceable by accident or disease will be rapid, in proportion to the shortness of the interval during which the deposition and subsequent removal and renewal of parts takes place. If this position be correct, we should suppose that in infancy and youth, setting aside the extensibility of all the tissues in early life, which is of material assistance to us in the treatment of partial ankylosis, a shorter time would suffice to engender structural and inextensible shortening of a muscle in youth than in adult life, as confessedly the processes of decomposition, renewal, and growth, take place in much more rapid succession in early life than at later periods. This supposition, as far as my experience has hitherto reached, is confirmed by observation. If the muscles of a limb have been contracted four or five years from the *constant* repose of the latter in a given position in two individuals, the one a child or youth, the other an adult, it will be found that, apart from whatever interstitial and extraneous deposit of lymph may have taken place about the articulation, the contracted muscles of the child will be less readily stretched out than those of the adult. It may here be observed, that, diagnosticating in all such cases of ankylosis from rigidity of muscles, we must be certain that no deception be practised by the patient, and ascertain positively, if possible, whether the limb has really been as much bent as long as may have been asserted; and whether on no occasion whatever, it has been straightened.

The rationale of the occurrence of this structural shortening, is in my opinion as follows.

There exists a certain relation between the growth and development of various parts, and their being constantly and properly exercised in the performance of their allotted function, their being kept in a state of activity; this does not apply merely to the increased thickness of muscles, which follows so notoriously upon augmented action, nor is it a consequence of the nervous energy being supplied to the parts from the nervous centres in a greater or less degree, as it takes place in other parts besides muscle, and where the supply of nervous energy undergoes no alteration; it seems to depend upon a providential law of the animal economy by which parts are increased or diminished according to the necessity for them. Thus when a healthy foot through spasmodic contraction of certain muscles is converted into talipes varus (a most common form of the vulgarly named club-foot,) and has its dorsal instead of its plantar surface turned towards the ground, so that the upper surface of some of the bones of the tarsus touch the earth; a common consequence of so unnatural a mode of progression is that the parts, irritated by contact with the ground, become protected by the formation of a huge bump of dense semi-elastic tissue. This bump, when examined, is seen to consist first of thickened cuticle and cutis, beneath which is a soft globular cushion of adipose tissue; to this succeeds a fibrous growth, denser than usual, consisting of the hypertrophied fascia and ligaments; immediately upon the bones this appears to become semi-cartilaginous, and lastly from deposition of osseous particles in the latter, the bone appears to be covered with bony incrustations. So that we have formed for the protection of the dorsum of the foot from being wounded by attrition, a mass gradually increasing in density, as it is examined from without inwards. Again, when a foot thus distorted from birth, is restored to its natural form and the patient's heel is made to touch the ground, the dense ligamentous and adipose cushion, which covers the under part of the heel of a healthy foot, becomes here much increased in size. We have innumerable instances of this, in the progress of surgical diseases. On the contrary when muscles, from whatever cause, are thrown into a state of *constant* contraction either passive (from rest of the limb in a certain position), or active (from spasm), not only do they become wasted in bulk, as is commonly stated from want of use, but the muscular fibres become permanently shortened, inelastic, not merely because having been long contracted the individual parts have become adherent to one another, but a period sufficiently long for the complete renewal of their integrant parts having elapsed, the individual fibres are rendered positively shorter, in consequence of the altered relation of parts; and we might as well think of stretching a living biceps beyond its extreme natural length by means of weights attached to it, as to attempt to elongate muscles integrally shortened after long continued contraction, with the aid of manipulations and the best contrived mechanical instruments, unless continued for a time so long that perseverance would be almost impossible. Indeed I have often found that the long continued attempts in such cases to stretch the muscles, have had the same effect, as exercise upon healthy muscles, namely to increase their bulk and consequently their resistance. The reader must bear in mind, that I allude to muscles contracted longer than the time during which physiologists believe the integrant parts are renewed; and pathological experience, I have stated, tells us that this period is long in adults, as long standing partial ankyloses, which have taken place after the attainment of manhood, may be cured solely by mechanical means after many years duration. But in children it is often otherwise; partly on account of the cause I have just discussed, and from another equally striking cause, although neither have, as I am aware of, been noticed by practitioners. During the time that muscles on the one side of a limb are contracted from any cause, and are undergoing interstitial shortening in the manner I have described, the bones advancing gradually towards their full development, shoot out and become lengthened; and thus the disproportion between the length of the contracted muscles, and the function they should perform is increased; and the deformity of the limb is usually augmented, unless well applied mechanical means have kept it stationary. Hence another cause, cæteris paribus, why there is more actual elongation to be accomplished in children than in adults.

All these circumstances considered, in relation to the particular case of partial ankylosis of the knee, which I have begun to detail in this paper, combined with the knowledge of the fact that the best mechanical skill had been for twelve months completely frustrated by the unyielding state of the muscles, I concluded that nought would overcome their resistance but their division with the scalpel.

What share had the evidently contracted gastrocnemii in maintaining the ankylosis of the knee, and what was the nature of their contraction, were however the next queries to be solved. The wasted muscles of the calf formed a strong broad band, extending from behind the lower end of the femur to the posterior extremity of the os calcis, which points of origin and insertion were approximated, accompanied, therefore, with the flexion of the knee and so-called extension of the foot upon the leg, so that the heel was constantly drawn upwards. Pressure with the hand against the point of the foot served to bend the ankle joint somewhat, but this tended again to increase the flexion of the knee; nevertheless the gastrocnemii were more elastic, the attempts to elongate them were not met by a resistance so stubborn as that offered by the flexors of the knee, although whatever little was gained upon them by a few minutes' pressure, was lost again when the hand was removed from the point of the foot. The explanation of the cause why there should have existed so great a difference in the nature of the contraction of the gastrocnemii, and that of the flexors of the thigh, will be understood by reflecting upon this case in connection with that which I have stated to be a second not uncommon cause of inextensible muscular shortening in children. Gradual contraction, during a long-continued state of rest, was the primary cause in both sets of muscles, tending to organic inextensible shortening: but there was the remarkable difference, that the thigh bone had grown considerably during the four years the disease had lasted; it had shot out to its proper length, thus greatly increasing the relative shortening of the flexors of the thigh, whereas, as I have stated, the tibia and fibula were atrophied, not only in their diameter, but more particularly as regards their length; they were at least three inches shorter than the corresponding bones of the opposite limb, so that although the same primary cause of the structural shortening of the gastrocnemii had existed, the bones of the leg having ceased to grow during the continuance of the disease in the knee, their contraction was much less rigid than that of the biceps femoris, semimembranosus, &c. I was of opinion, therefore, that there would be no necessity for the division of the tendo Achillis, but that on the contrary the gastrocnemii might be gradually elongated by an appropriate instrument, so as to bend the patient's ankle, and enable her to put the heel to the ground, removing at the same time, whatever bending of the knee depended upon their contraction.

The danger of reproducing the disease of the articulation, by performing an operation in its vicinity, and by a comparatively rapid extension of the limb disturbing the quiet state of the ligaments, was next to be considered. It did not appear to me, however, that any danger of this kind existed, as the disease had completely subsided two years before, and the patient's general health, which was good, though rather delicate, had, according to the report of the gentlemen who had attended the patient, so much improved since that time, and particularly when compared with her evidently strumous state, when the disease commenced. To proceed very cautiously however, I determined to carry on the necessary extension after the operation, as slowly as possible; and should the least indication of an untoward result occur,—any symptoms threatening a renewal of the knee-joint disease—I resolved to suspend the extension, or lay it aside altogether. The only remaining question was, whether, if the operation proved successful and the knee were straightened, the patient would have a limb (shortened and wasted as were the bones and muscles of the leg), sufficiently useful to repay her for the pain and risk of the proceeding. The most desirable termination possible of this case would be, that the patient should obtain a bent ankle, a straight knee, and the power of moving them in either direction, flexion and extension. That she would obtain the first, there could be little doubt; as to the second, it was most probable. She would also obtain the power of moving the ankle naturally; but as to usefully moving the knee-joint by voluntary muscular efforts, the prospect was very distant, as not only the inadequate condition of the flexors of the thigh as respects power had to be considered, but it was impossible to decide upon the competency of the articular surface of the three bones of the knee to perform their natural office. The really important point was to straighten the knee, which, if accomplished, supposing it even to remain fixed in the straight position, would alone amply requite a patient and parent for all the pains and troubles of an operation succeeded by mechanical treatment. Upon that judgment alone, I recommended the operation, considering, that although the patient would for some time require to use a stick, and constantly a cork-raised shoe as some substitute for the atrophied bones of the leg, a straight knee and leg, with the ankle restored to its natural motion, were a preferable alternative, either to the necessity of getting about upon two crutches with a knee bent to an angle more acute than a right angle, or to an amputation, which had been more than once proposed as the ultimatum. If the limb were straightened, and the knee was immovable in its newly acquired state, there would be no difficulty in bending it by the same mechanical means which had straightened it, if that were thought desirable. And again, if before the limb became thoroughly straightened, much inconvenience and pain, or any other disagreeable symptoms were to occur, so as to require the discontinuance of the extension, the question arose, whether, considering the partial luxation of the head of the tibia backwards, the patient would not walk with greater comfort and less apparent lameness, with the knee slightly bent, than with it absolutely straight.

The operation was rapidly completed in the following manner, observing the same precautions as in dividing tendons for the cure of congenital or acquired contraction of the ankle, called club-foot, &c., namely, to divide the tendons, with no more disturbance of contiguous parts or breach of surface, than may be absolutely necessary to procure immediate union of the wound, if possible, and not to exert any extension of the joint until adhesion have taken place ; as, by following an opposite course, through an useless anxiety of seeing whether the limb can be straightened, inflammation and suppuration might be induced and endanger success. The propriety of making extension immediately after an operation is negatived by the results derived from experience, viz. that divided tendons, like fractured bones, do not unite *firmly* until a considerable time has elapsed ; by obtaining an immediate union of the skin, (which has followed without one exception, in more than sixty cases in which I have treated contractions of the ankle by division of the tendo Achillis, &c.,) the divided tendon is reduced to the state of a simple rupture, which, compared with a suppurating wound of tendon, is analogous to the difference between simple and compound fracture of a bone.

The patient was placed upon her face and abdomen upon a sofa, the point of the knee resting upon a pillow ; one assistant supported the thigh, whilst another, with his hand upon the back of an ankle, used the leg as a long lever to act upon the knee-joint, by which the tendons were kept perfectly tense.

The knife used by me for the division of the three flexor tendons of the thigh, in the case I am relating, was a very narrow convex-edged scalpel, the point of which I introduced through the integument at the back of the articulation, to the outside of the tendons of the semi-membranosus and semi-tendinosus muscles, with one of its flat surfaces directed towards those tendons. The point of the knife was carefully glided beneath them, its cutting edge turned towards, and pressed against them, by which they were immediately severed, owing to their being held well upon the stretch. The knife being withdrawn, the integument was stretched by the fingers of my left hand, a little outwards, so that the puncture by which the semi-membranosus and semi-tendinosus tendons had been divided, was brought directly above or somewhat to the outside of the biceps tendon, which was now felt to be the only tendon undivided, whilst with my right hand, I introduced beneath the biceps, through the same puncture of the skin, a small curved bistoury, having a concave cutting edge, by which the tendon was instantly divided. A small quantity of arterial blood flowed, which ceased by slight compression with lint. Adhesive plaister and bandage were applied. The patient was made comfortable, and left quiet upon the sofa ; she complained of pain in the divided part, and some numbness of the skin behind the joint, as if some filament from the sciatic had been injured. She ceased to complain of these a quarter of an hour after taking ten minims tr. opii. She had no fever or constitutional disturbance ; the wound united perfectly by adhesion ; so that on the third day after the operation, the apparatus for gradually extending the joint was applied. I had the satisfaction of seeing the limb rendered daily more and more straight, without any pain or sense of resistance being felt in the divided part, or in the back of the thigh ; her chief complaints having been that of irksomeness, from having the limb constantly more or less compressed by the straps of the apparatus, and occasionally pain in the front of the articulation, whenever the extending screws of the apparatus were turned. At the expiration of two months the knee was becoming nearly straight, and I considered the time arrived for attending to the ankle, the extension of which in a patient of less excitable disposition would have been carried on simultaneously with that of the knee. The contrivance for effecting that, was set into operation ; but my patient's health not being improved by the necessity of keeping her so long within doors, owing to the severity of the late winter, and neuralgic pains in the face to which she had been subject coming on, induced me not to subject her delicate frame to daily trial, but rather to advance with the extension by the most insensible degrees. This determination was arrived at by me the more willingly, as an elder sister had died of tubercular phthisis, and argument might not stem the prejudices of affection, should any serious deterioration of her health have ensued ; for in such a case, the operation would be impugned as a cause of that or perhaps of any subsequent misfortune, whereas, in truth, the cure of a patient's limb, by restoring the individual to hilarity, air, and exercise, would be one of the most certain impediments to a strumous or consumptive tendency. Not a single unpleasant event, however, has occurred during the treatment, beyond two slight abrasions of the cuticle ; the ankle is restored to its natural state, the knee is very nearly straight, and the patient can voluntarily move the joint, flexing and extending it sufficiently to show that the divided tendons have firmly re-united, and that the long-lost action of the muscles is restored. With a sufficient thickness of cork beneath the sole, to compensate for the shortness of the tibia, she is able, six months after the operation, and after nearly five years' confinement to the sofa, to help herself about with a stick, and as the muscles of both limbs, weakened by long inactivity, acquire power, she will doubtless lay the former aside, and walk with considerable ease and freedom. The time occupied by the treatment of this case, short as it is, compared with the results obtained, might, under ordinarily favourable circumstances, as in an hospital, or with a patient whose health and age would enable the surgeon to advance uninterruptedly with the treatment, be considerably shortened, reduced indeed, with safety and propriety, to six or eight weeks.

In all such cases, treated by operation, the adjuvant treatment of warm and steam baths, liniments, frictions, and manipulations, should not be omitted, particularly after the extension by instruments has been accomplished, in order to obtain freedom of motion, and prevent any tendency to recontraction of the restored limb. I have detailed the nature and progress of this case, not merely on account of its individual worth, but because it illustrates my opinions relative to partial ankylosis, and some of its proximate causes, and because, beyond the brief notice of M. Duval having done the same operation, (Lancet, No. 15, Vol. I. 1837—38,) as it had also previously been done several times with success by Stromeyer of Hanover, and once by Dieffenbach of Berlin, I am not aware that any thing of the kind has been published in our own or in the French and German languages.

Of the ankyloses depending entirely or partly upon the muscles, I have in this place to consider the treatment of those cases only which come under the first of the four sections, in which I have included all the varieties of partial ankylosis which have presented themselves to me; namely, those cases which arise from sloughing, or from adhesions of muscles to one another and to the bones, as those (*partial ankyloses*) which come under the second and third sections, i. e. depend primarily upon *spasmodic* contraction, or upon *organic* contraction through *paralysis* of antagonists, will be more appropriately considered in the articles Contracture, Club-foot, and Paralysis, to which the reader is referred.

Where a considerable extent of muscle has been lost by sloughing, or rendered unserviceable by adhesion to the fasciæ and particularly to the bones, any method which might enable us to restore to the ankylosed limb its natural form and motion, would of course be unavailable in the restoration of the integrity of the tissue, or its function; but where numerous muscles, as in the thigh or leg, concur in the motion of an articulation in a given direction, the major part of one or more muscles may not only have been lost, or owing to adhesions rendered useless as regards their particular office, but they may also interfere with the functions of all the neighbouring muscles, by forming tight cords or bridles, thus limiting the motion and inducing incomplete ankylosis of the adjacent joint, or indeed joints, if the injured muscle passes over two articulations, as the gastrocnemius for instance does. In these cases much may be done by extension with appropriate apparatus, but a cure can seldom be attained by mechanical means only, unless the morbid alteration of the form of the joint be trifling, or the affected muscles or the bands of adhesions be small, and capable of being easily elongated by stretching: even in the smaller joints of the body, partial ankylosis from sloughing or adhesion of tendons and muscles, is seldom cured by merely mechanical means; still less successful are we in overcoming the deformity by such means, when one of the larger joints, as the ankle for example, is affected. In two cases of partial ankylosis of the ankle-joint in the extended position, the result of abscesses involving the gastrocnemii muscles, with caries of the bones in the one case, and extensive necrosis in the other, I have been obliged to have recourse to division of the tendo Achillis, which was followed by perfect and rapid success. These cases are related at length in the Lancet, (Vol. II. 1837—38, p. 290, 338,) an abstract of which I give here.

July 27, 1837.—Miss ———, ætat. 24, informs me that some disease of the right leg, supposed at first to have been rheumatic inflammation, commenced nearly nine years ago, and continued four years, during which period she had numerous abscesses in different parts of the back and outside of the leg, from several of which large pieces of bone were removed. When the wounds had entirely healed, and she had recovered her strength, she found herself unable to touch the ground with more than the front of the foot, the ankle-joint being almost immovably fixed in the straight position, the heel drawn up from the ground between two and three inches, and her walking rendered consequently very difficult, which has continued so, as she says the great fatigue and perspiration after going half a mile are very distressing to her. The gentleman who had attended her, placed her under the care of a mechanist of repute, who undertook, by appropriate apparatus, to overcome the contraction of the calf and force the toe gradually upward, and the heel down to the ground. This plan has been persevered in by the almost daily attendance of the mechanist ever since, up to the present time, without any other benefit than that of having prevented the contraction from increasing.

August 1.—I divided the tendo Achillis, using a very narrow straight bistoury: The patient being seated in a chair, one assistant supported the knee, whilst another, grasping and drawing downwards the patient's heel with his left hand, and pressing upwards the toes and front of the foot with his right, rendered the tendon to be divided as tense as possible. After feeling with my left thumb and forefinger the outline of the tendo Achillis, in this case partially connected to the surrounding parts by adhesions, I passed the small bistoury through the skin, one or two fingers' breadth above the malleolus internus, with one of its sides turned towards the tendon and immediately above it, (the patient sitting), the other directed towards the deeper muscles and the tibial vessels and nerves ; and as soon as I knew that the point of the knife was passed beyond the external edge of the tendon, and had nearly reached the skin of the opposite side, I turned the knife so as to bring its cutting edge to press against the tendon, which was cut at one stroke, on withdrawing the knife. The recoil of the severed ends of the tendon was distinctly felt and heard. The puncture was dressed with a strip of adhesive plaister and bandage, and the limb as usual laid in its deformed position upon a common pasteboard splint.

Second day after the operation.—The dressing was removed, and the puncture found to have united by adhesion. On examining the limb I felt a small string, or bridle, remaining undivided at the part where I had cut the tendon. It may have been the plantaris tendon, as it was upon the inside of the tendo Achillis, or a strip of fascia, or a small band of old adhesions. I divided it by a very minute puncture, and placed the limb, after dressing it, upon Strömeyer's foot-board, without exercising any extension.

Fourth day.—The cord of the apparatus tightened, for the first time, so as to keep a little tension upon the joint.

Seventh day.—The extension has been carried on slowly, and without inconvenience to the patient, except from the pressure of the apparatus against one of the corns which cover that part of the sole upon which she trod formerly. A friend of the patient undertook this morning to remove the projecting part of the corn which occasioned the pain, in doing which he unfortunately wounded the cutis ; this little accident has occurred most inopportunely, as the tenderness which may result therefrom will prevent me from persevering with the use of the apparatus to rectify the position of the foot until it has perfectly healed.

Tenth day.—The apparatus has continued to be worn, but the anticipated inflammation around the corn has required the application of poultices, and prevented any progress being made. The pain in the sole is subsiding, and the little wound made through cutting the corn is healed ; the extension, therefore, is now to be pursued.

Eleventh day. — Patient has complained much of pain in that part of the foot covered with the corns ; so much, indeed, did she suffer during the night, that being summoned to her, I was obliged to loosen the apparatus, although it was by no means tightly applied. The slight, though constant pressure, had sufficed to re-excite inflammation of the skin around the corns. In order that the pressure of the foot-board may hereafter be distributed equally over the entire sole, I have placed between it and the foot-board a temporary air cushion, which I have prepared by introducing one portion of the gut of a bullock within a second portion of the same, tying the double intestine firmly at one end, then inflating it and securing it at the other. This contrivance was no sooner applied than she expressed herself totally relieved from soreness and pain ; she could even bear immediately a much greater pressure than I thought necessary for the gradual forcing upward of the toes ; in short, she was rendered more comfortable with the foot-board on than without it, as the elastic uniform pressure against the entire sole, eased her at once from the burning pain of the inflamed skin around the corns.

Twelfth day.—My patient is delighted with the progress she is making, as the heel has visibly descended, and I, that my experiment with the air cushion has succeeded so perfectly. To-day I have substituted for the inflated intestine a properly made caoutchouc air cushion. I have directed her to walk about the room, so as to assist the thrusting down of the heel, by throwing the weight of the body upon her foot. All pain in the corns is gone, although she is beginning to complain of pain in the situation of the ligaments of the joint. Spirit lotion to be applied constantly to the ankle.

Sixteenth day.—The foot-board has been very well borne since last report ; I have removed it to day, and allowed her to walk across her apartment, the entire sole and heel of the foot touching the ground, without any apparatus ; I have, however, re-applied it, intending to bend the ankle to such an extent that the foot may form an angle with the leg as acute as natural.

Twenty-second day.—The foot is now bent almost as much as is necessary to ensure perfect walking by-and-by. I have discontinued the foot-board, and have applied instead a lighter instrument of my own, which combines the perpendicular elastic springs of the Scarpa shoe, for the cure of club-foot, with a certainty of bending the joint to the natural extent, by means of a screw, acting against the spring as a lever ; she can, therefore, walk about with facility and ease. All the inconvenience she has now is from tenderness of the ligaments of the joint which have been stretched.

Six weeks after the operation she walked about in a common shoe, the ankle joint possessing the natural extent of motion ; at the end of two months, when all œdematous swelling had subsided, the union of the tendo Achillis could be felt to be perfect, and by means of the gastrocnemii, tib. post., &c., she could straighten the foot upon the leg, and contract freely the anterior tibial muscle, and raise the foot; the peronei had also recovered their power. She suffered occasionally, during the very severe cold weather, from pain in the ankle-joint, which for a short time caused her to walk rather lamely. Her gait continued to improve until four months after the operation, when she was walking about as well as a person who had never had any lameness.

The second case is still more interesting, as the ankylosed, almost immovably rigid state of the ankle-joint had existed twenty years, and although the treatment was more embarrassing than the preceding, through the greater destruction of soft and hard parts, and the consequent numerous adhesions in all directions, its complete success shows how valuable an improvement in the treatment of some cases of partial ankylosis we possess in the division of tendons.

Sept. 4, 1837.—Miss ——, aged twenty-seven, informs me that when about seven years of age, she was attacked with some disease in her right leg, accompanied by numerous abscesses, ulcerations, fistulæ, &c., the last of which closed twelve years ago. During the continuance of this protracted disease she was necessarily prevented from walking, so that on its subsiding it was found that the extended state which the foot assumes, owing to the superior power of the gastrocnemii, and other muscles on the back of the leg, overbalancing the anterior muscles when the influence of volition is not exerted,—a state in which the foot had remained so many years,—combined with the gradual contraction of the numerous cicatrices, had produced a permanent elevation of the heel, from the ground to the utmost possible extent. At the present time she walks upon the extreme point of the sole of the foot, corresponding to the metatarso-digital articulations, where there exists the usual painful corn, which in such feet covers the cutis, wherever it is subjected to undue friction or pressure; the heel is drawn upwards by the contracted muscles of the calf as much as five inches, which distance from the earth it retains even when the entire weight of the body is thrown upon the affected limb, or the patient strains to force it down; so rigid, indeed, is the contraction, that no efforts which I can exercise to force up the toes, procure the least alteration in the form of the foot. There is no deformity of the foot itself beyond the fixed state of so-called extension, and a somewhat greater convexity of the arch of the foot than natural. All the muscles of the affected thigh and front of the leg are weaker than those of the opposite side; those of the back and outside of the leg are bound down to the bones by ten or a dozen large indented cicatrices, some of them more than three inches in length. She can produce no voluntary motion by any action of the anterior muscles, through their being kept continually upon the stretch, nor by the posterior muscles, from some of them being firmly bound down in various parts to the bones, and from the remainder being already contracted to their fullest extent. The entire extremity, owing to the fixed straight position of the foot, is rendered longer than that of the opposite side, although the tibia and fibula, being about an inch shorter, by comparison, than they should be, diminish by that much what the excess in length of the extremity would otherwise have amounted to, and, together with the studious efforts of this young lady to conceal her lameness, by walking leisurely, and as much as possible upon the toes of the sound leg, renders her deformity less evident than it otherwise would be. She tells me, however, that she is incapacitated from standing long, walking far, or upon a sloping or uneven pavement, without considerable pain and fatigue. That no true ankylosis of the joint exists, is known by the lateral motion which can be given to the astragalus and tarsus, by moving the toes alternately inwards and outwards.

The indications of cure were to divide the tendo Achillis, as in similar contractions from other causes, and by gradual stretching by the appropriate apparatus, to obtain, if possible, the full natural extent of motion of the ankle-joint. But there were difficulties in the way of an operation—the lowest cicatrix uniting skin, bones, and tendo Achillis, approached so near to the insertion of the latter into the os calcis,—within an inch of it,—and the distance between the anterior surface of the tendon and the back of the ankle-joint, which is occupied in a healthy limb, by yielding cellular tissue, appeared from the thickening and induration around the tendon, to be filled up by so dense a mass of organised lymph, that there remained no part of the tendon, at which its section could be very conveniently accomplished. There was the necessity of keeping sufficiently far from the bursa, at the insertion of the tendo Achillis upon the one hand, and the objection of traversing old cicatrices with the knife on the other. As, however, I was convinced that with the division of the large inelastic tendo Achillis, and as much of the subjacent indurated cellular tissue as I could, with safety to the tibial vessels and nerve, reach (unless that which might be left undivided were completely fibro-cartilaginous), much more than half of the obstacles to bending the joint would be overcome, I did not hesitate to undertake the treatment of the case, upon the same principles as those which guide me in the uncomplicated congenital or non-congenital club-foot.

Sept. 7.—Divided the tendo Achillis, using a small straight French bistoury. I passed the knife into the inside of the limb, opposite to the part where the tendon was least engaged by the adhesions, as far from the anterior surface of the tendon as was compatible with the safety of the posterior tibial vessels, &c., one side of the knife being directed towards the latter. The cutting edge was then directed outwards, against the tendon, the point being made to describe a quarter or third of a circle, of which the centre was that part of the blade in contact with the external punctures. By this cutting outwards, and circular motion of the point of the knife, nearly all fibro-cartilaginous adhesions, (for they were felt by me to be gristly whilst cutting them,) between the edge of the knife and the skin, as well as the tendo Achillis, were divided, as in the method I usually adopt for cutting the latter only, without any puncture being made in the opposite side of the leg. After the withdrawal of the knife two small remaining portions of fascia, or bands of adhesion, were felt through the integuments to be still unsevered; they were cut by reintroducing the bistoury. There was but one wound, a quarter of an inch in length, which healed the second day by first intention.

On the sixth day Stromeyer's foot-board, with an air-cushion beneath the sole of the foot, was applied, without attempting much extension of the remaining resisting tissues of the back of the leg, viz. the tibialis posticus, flexor muscles, and the ligaments of the joint, as I judged it prudent to proceed more gradually than after an ordinary section of the tendo Achillis, and allow the lymph effused in the track of the knife, through the tendon and through the old cicatrices, to become more fully organised, that there might be no chance of exciting any degeneration of the reparatory process, or inflammation, notwithstanding the part was completely healed.

After a few days, the cord of the apparatus was slowly tightened. The patient complained of having restless nights, took a few doses of tinct. opii unavailingly; did not refer the pain she endured from the apparatus to the situation of the lig. deltoideum and fibulare posticum, (to the former of which, in particular cases, after the operation for club-foot, patients point as the part where they feel that stretching is going on,) but complained chiefly of an acute pain at the back of the fibula, two inches above the malleole. At the eighth day of carrying on the extension, I found, to my disappointment, that the foot was nearly in the same position as before the operation, the heel having descended only a very little; I was certain, therefore, that some unusual impediment to the bending of the ankle existed; and as there was a cicatrix adherent to the bone, and a little inflamed, as if it had been on the stretch, and at the place where she complained of pain and stretching, close to the situation of the tendons of the peronei muscles, I suspected that the latter might be interested in the cicatrix, and adherent to the fibula, although before the operation I believed them to be free; I resolved, therefore, that if a subsequent examination confirmed me in my suspicion, I would divide those tendons lower down than the cicatrix. The bandages and apparatus were removed altogether; the spirit lotion prescribed to be applied constantly to the ankle, and a dose of laxative medicine to be taken, to accelerate the removal of œdema of the parts which obstructed an accurate examination.

On the eighteenth day after the division of the tendo Achillis, when all swelling had subsided, I was able to satisfy myself of the state of things. There was no adhesion of the peronei tendons at the cicatrix, for when the ankle-joint was moved as far as the deformity admitted, I could feel that they were rendered alternately tense and lax, both below and *above* the cicatrix. The latter was still slightly red and puffy; when I attempted to press the toes upwards she had pain there, ranging from the cicatrix to the posterior extremity of the os calcis, and by careful manipulation I discovered what I supposed to be a firm band, passing from the os calcis, or from the inferior portion of the divided tendo Achillis to this lowest cicatrix of the fibula. Pressure in the direction of this band gave pain, as did also, upon repeated trials, the forcing upwards of the toes. I determined consequently, to divide it between the cicatrix and its connection with the lower part of the tendon, which was done after the manner of dividing a tendo Achillis, except that I introduced the knife upon the outside of the limb. The wound where the knife entered healed the second day, but a minute puncture made by the curved point of the knife, in the posterior median line, was more slow to cicatrize. Stromeyer's foot-board was now immediately re-applied, and the same degree of extension which produced before much pain and uneasiness, was borne after this second operation, with comparative ease, so that she was able to walk about; the heel gradually descended, and on October 9th, fourteen days after the second operation, she was able to put the heel and entire sole to the ground, which she had not done for twenty years. A lighter modification of the apparatus was worn three weeks longer, to support the joint whilst walking about, and also (although the foot had now acquired, in the eye of a cursory observer, a perfectly natural form,) to endeavour, if possible, to bend the ankle beyond a right angle with the leg, and obtain the full extent of natural motion. The wearing of this latter instrument occasioned not the slightest uneasiness; it was rather a source of ease to her, for when the foot was allowed to hang loose, owing to the anterior muscles of the leg having been so many years elongated, and therefore unable to hold the foot in the bent state, she, as all patients for a short time after the operation do, felt pain from motion of the recently disturbed parts about the joint, ligaments, &c.

Nov. 5.—All apparatus laid aside, and patient is now walking about with a common shoe on; her gait is like that of a person just recovered from a sprained ankle, or broken leg, putting the foot cautiously to the ground, and turning the toes outwards, in which position the ankle is bent as little as possible, to avoid motion of the yet tender ligaments of the joint. Her only complaint is, that her leg feels so much shorter than it was formerly, or than the other now is, the bones of the leg, as was stated at the commencement of this report, being nearly an inch shorter than those of the opposite extremity ; but the impression whilst walking is, that the limb is at least three or four inches too short, which arises from a false sensation, depending upon the former greatly elongated state of it. Her spinal column and pelvis, and the vertebral and pelvic muscles, had accommodated themselves to the unnatural length of the deformed limb, and therefore as the ankle-joint is restored to its proper action, and the limb shortened as much as the heel was formerly elevated from the ground (five inches), it is not surprising that the change to her feelings should be so remarkable, and the nature of it so deceptive. A bystander would remark, that even now that the foot is cured, and she has been walking about upon the heel three weeks, the shoulder of the affected side is thrown higher than the other, so slowly do the pelvis and vertebral column right themselves after having been obliged to assume an unnatural position so many years.

At the present time, six months after the operation, she is able to walk and dance almost as well as if she had never been the subject of partial ankylosis.

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(*W. J. Little.*)

ANKYLOTOME, the same derivative, and *τέμνειν*, 'to cut.' A general name for curved knives of every kind. According to Scultetus, it was used to designate a curved knife formerly in use for dividing the frænum of the tongue.

ANTEVERSION, UTERUS OF, from *ante*, forwards, and *vertere*, to turn. *Anteversio*, Lat. A displacement of the uterus, in which it turns upon its short axis, the fundus of the organ being carried forwards and downwards towards the pubis; the orifice backwards and upwards towards the curvature of the sacrum. In this position, the large diameter of the organ is horizontal. (See Uterus).

ANTHRACOSIS, Lat.; *ἀνθράκωσις*, Gr.; *anthracose, charbon des paupières*, Fr.; *Augenbrand*, Ger. A variety of anthrax which attacks the eyelids, sometimes in bad cases involving the destruction not only of the lids, but of the globe of the eye itself. It is a very rare affection, and is observed almost exclusively in persons who have long endured privations of every kind, and who have been addicted to intemperate and squalid habits. (See Anthrax.)

ANTHRAX, *ἄνθραξ* (coal) Gr.; *carbo*, Lat.; *anthrax*, *charbon*, Fr.; *Karbunkel*, Ger. By this term is designated the inflammation of isolated portions of the dermic cellular tissue. Anthrax presents itself as a circumscribed hemispherical hard tumour, more or less extensive, in proportion to the number of the cellular fasciculi involved ; the centre of the tumour, at first of a dull red, soon assumes a livid or dark colour, which extends over its entire surface ; the pain is at first but slight ; it gradually increases till it becomes fierce and burning, and so continues until the excessive tension of the parts is taken off by appropriate treatment, or they become deprived of sensibility, by the supervention of gangrene.

The terms *anthrax* and *carbuncle* are often used synonymously. Dupuytren, however, has shown that their differences are more decided than had been supposed, and that they do not depend solely on the degrees of violence accompanying an attack. The gangrene that occurs in the pestilential carbuncle, or malignant anthrax, arises from the nature of the disease itself, namely, the absorption of some deleterious substance, while in the anthrax properly so called, it is simply a result of the constriction of the parts, and may to a great extent if not altogether be obviated by treatment.

Pathology.—In order to comprehend the mode in which this constriction of the cellular tissue is effected, it will be necessary to say a few words as to the difference of relation which that tissue presents in regard to the chorion, as compared with the state in which it is found, as strictly *subcutaneous*. The subcutaneous cellular tissue is free from the admixture of any other elements more resisting and inelastic than itself; but not so the cellular tissue of the derm. The deep-seated layer of the skin receives prolongations accompanying the vessels and nerves, from the subcutaneous cellular tissue, and which are lodged in its fibrous cells. Every areole or cell of the deep surface of the derm is thus filled with cellular tissue. If an inflammation attacks one or more of these cellular bundles, they become distended beyond the power of yielding of the fibrous areoles in which they are contained; while the cells in their turn compress and strangulate the engorged cellular tissue, and hence both elements are disorganized,—the fibrous cells from distension, the cellular tissue from strangulation. The same condition of parts characterizes furunculus ; but in the latter case, the number of bundles of the cellular tissue affected is very small, seldom more than one or two. The only difference therefore, between anthrax and furunculus is one of extent; that of the former having sometimes a diameter and elevation of several inches.

Causes.—Anthrax is usually described as caused by irritating applications to the skin, or as a common coincidence, if not a consequence, of gastro-intestinal irritation. The predisposing causes, however, are often much more obvious than the immediate. Habitual excess in eating, with the abuse of fermented liquors, and disorder or want of tone in the assimilating organs, are enumerated amongst the causes that produce anthrax. It is also sometimes observed in the termination of measles, small-pox, and fevers of a typhoid character. Generally speaking, it occurs most commonly in those parts of the integuments which are thickest and best supplied with cellular tissue, on the back of the neck, the back, the nates, the thighs, the thorax, abdomen, axillæ, loins, and jaws. Unlike the furunculus, of which several may exist together, or follow each other in succession, the anthrax is usually single, more especially if extensive; there are, however, exceptions in this respect.

The progression observed in the phenomena belonging to this affection seems to sanction their classification into different periods or stages. In the period of attack, a pimple is first observed, the basis of which, small at first, rapidly extends. It is often not at all painful at the outset, the sensation being merely that of itching. Sometimes a small tumour exists before any pain or itching is felt, and is discovered only by accidental touching. Confined in the beginning to the cellular tissue of the chorion, the inflammation soon extends to the subcutaneous cellular tissue; the tumour which has the feel of brawn, gains on the surrounding surface in every direction, and seems almost immovable in the midst of the parts in which it has become developed. Over the most elevated points phlyctenes are formed, which breaking, give issue to a watery or sanious pus; and the cuticle peels off. The strangulation of the dermic cellular tissue is now at its height; the pain has acquired a peculiarly severe and burning character, and symptoms of constitutional reaction become manifest. The appetite is diminished, or null; the sleep disturbed, or altogether prevented, the stomach and bowels are disordered; if the tumour be very large, the skin is dry, the urine high-coloured and scanty, the headach is severe, and sometimes delirium supervenes.

Besides these features, which may be considered as general and characteristic, there are others which are accidental, and consequent upon the situation in which the anthrax is developed: thus the pain and tension are so great as seriously to impede the functions of the neighbouring parts, as of deglutition, or respiration, when the tumour occupies the neck, or the walls of the thorax, and of defecation, when it is seated in those of the abdomen, &c.

Except in the very rare cases in which resolution is effected at an early stage, this inflammation runs its course until it terminates in gangrene, both of the fibrous areoles of the derm, and the cellular tissue contained in them. Once reduced to this state, they form a core, or disorganized mass, which by means of a new process now set up in the surrounding parts, is ultimately eliminated. This is the commencement of the second period. The cellular tissue surrounding the core is engorged, lymph is effused, and pus, at first in small quantity, is secreted. If left to itself, the skin covering the tumour, deprived of its cuticle, grows thinner, till at last the fibrous cells are denuded, and the disorganized mass becomes visible through the fibrous partitions, which still resist its expulsion. One after another, these little inflamed bands give way, and a large aperture is formed, through which a soft whitish or grey flaky mass of mortified cellular tissue slowly advances. The pus which accompanies it is not abundant, but exhales a peculiar and very offensive odour. Towards the end of this stage, and in proportion as the disorganized mass becomes detached from the living parts, the pus increases in quantity, and exudes from the sides of the eschar on the slightest pressure. The dead parts are at length thrown off in mass, or flakes, leaving a suppurating cavity, large and deep in proportion to the loss of substance. When the destruction of the subcutaneous cellular tissue is extensive, the muscles, tendons, and aponeuroses are denuded, and sometimes the fibrous sheaths themselves are seen perforated, and purulent sinuses extend beneath them in various directions. After the expulsion of the mortified mass, the engorgement and induration of the surrounding parts persist often for a considerable time. The edges of the solution of continuity are of a livid hue, deprived of cuticle, and thinned to such a degree, from the destruction of the subcutaneous cellular tissue, that they often perish extensively, or, if preserved, show but little tendency to cicatrize.

In the third stage, the suppuration either diminishes gradually, granulations spring up from the bottom of the cavity, and cicatrization proceeds favourably, or extending further, the suppurative action is prolonged indefinitely, and the patient is exhausted by the excessive discharge.

The duration of the disease varies considerably, its progress in some being much more rapid than in others; generally speaking, however, it is in proportion to the violence of the attack, and the vigour of the patient. If the disease is extensive, the eschar is not formed till the twentieth, nor is it completely thrown off till the fortieth or fiftieth day. The suppuration and cicatrization may occupy, as has been already observed, an indefinite period.

Prognosis.—When the anthrax is extensive and rapid in its progress, especially if the constitution is much shattered, the prognostic is highly unfavourable. The reverse of these conditions, it need scarce be added, will justify a more favourable augury. The danger to life is relative to the age of the patient, the extent of the parts attacked, the violence and duration of the irritation, the exhaustion from long-continued discharge, and the situation in which the tumour is developed. This last point is one of the utmost importance, as the local irritation is readily transmitted to the neighbouring organs. It is on this account, that bad consequences are so much more to be dreaded, when an anthrax occurs in the vicinity of the great serous cavities; in the scalp, for instance, it is almost always fatal.

Local treatment.—When the surgeon is consulted at the commencement, and the tumour is not extensive, nor the pain yet severe, an attempt may be made, and sometimes successfully, to check its further progress by the application of numerous leeches, cold lotions, or emollient poultices. If the inflammatory irritation that first assails the cellulo-adipose pellets lodged in the areoles of the derm can be arrested, the disease aborts, and the patient is spared much suffering and risk. But when these measures fail to produce the desired effect, he must not lose time; promptitude and energy will be necessary not only to relieve the patient of pain, but to limit the ravages which the disease, if left to itself, would not fail to produce in the parts attacked. The inflamed cellular pellets, shut up in the unyielding cells, are suffering the passive pressure of the aponeurotic derm, and this pressure will go on augmenting till both perish together; a consequence which can only be prevented by freeing the parts from this state of strangulation. This is effected by multiplied incisions extending through it from the summit to the base of the tumour, and prolonged beyond its limits for a little way. The number of incisions should vary according to the extent of the tumour; the crucial or stellated form is that generally preferred. If they are made sufficiently early, the pain ceases almost at once, the duration of the disease will be greatly abridged, and the gangrene that would otherwise result will sometimes be prevented altogether. If matter has been already formed, it is squeezed out on the divided surfaces, and a good deal of blood is poured out, which helps to subdue the inflammation. The effect of crucial incisions in removing the constriction of the parts, and producing the cessation of pain, is well exemplified in a case of Dupuytren's. He first divided the tumour, which was about the size of a hen's egg, into two equal parts, one of which he again divided into two parts. These two incisions had the form of a T; the upper half of the tumour having been cut crucially, whilst the lower one remained undivided. As Dupuytren foretold, the pain ceased, and the inflammation was subsiding only in the upper half of the tumour, the lower one being found next day, still hard, inflamed, and much larger. The lower half was then divided, and its further progress arrested.

If the tumour happen to be so large, that the crucial incisions are insufficient to relieve the parts from constriction, then as many more as may be required are made, passing through the same centre as the two first, or in such other manner, as may seem best suited to the object the surgeon has in view, and the nature of the parts in which the anthrax is developed. It is important to bear in mind, that in order to arrest the progress of the tumour, the incisions should not only divide it completely through, but be prolonged a little way beyond it. The incisions having been duly made, and in sufficient number, either through the centre, or round the basis of the tumour, pressure should be made both on the tumour and the surrounding parts, in order to unload them of the pus and mortified cellular tissue which they may contain, and the whole is covered with an emollient poultice; sometimes a simple or digestive ointment is applied to the wound itself, and the poultice is then spread largely over the wound and neighbouring parts.

In some cases, the treatment by incisions is objectionable, on account of the situation of the tumour. When it is so, it should at an early stage be covered with leeches, and the bleeding encouraged by warm fomentations, or it may be cupped. The surgeon should then watch till the skin becomes thinned, and make a straight incision to give issue to the pus and gangrenous cellular tissue, and if one or more spontaneous openings have already formed they may be thrown into one by this incision. In pressing out the matter and sloughs, the degree of force employed should be moderate; for, setting aside the torture which severe pressure would produce, it would also retard the detersive and healing process by breaking up many small vessels. It will therefore be better to press the pus out gently at each dressing, and remove the flakes of cellular tissue as they become loosened and detached, than to force them away roughly. When the skin is extensively thinned by the progress of ulceration, it will not unite with the granulations that spring from the bottom of the wound. In this case the wasted integument, which is an obstacle to cicatrization, should be cut away with the scissors. When the suppuration diminishes, and the tendency to healing is obvious, care should be taken to watch the progress of the cicatrization, with a view to check exuberant granulations, or to prevent the parts from contracting adhesions, or taking positions which might afterwards interfere with the due performance of their functions. When the granulations have become regularized, and the edges have sunk to their level, they should be drawn near or into contact by means of adhesive straps, and dressed with lint, either dry, or spread with simple ointment; at this stage, the treatment being the same as that of any other wound with loss of substance.

Patients attacked with anthrax, under the impression that it is a mere boil, often refrain from consulting the surgeon, till finding that palliatives have no effect, they become alarmed, and present themselves, for the first time, with large eschars, accompanied by an abundant and extremely ill-conditioned suppuration. In such cases, great benefit will be derived in correcting the fetid state of the ulcer, from the use of the chloride of lime, either in poultice or lotion.

In situations where the treatment by incisions might be objected to, or where the anthrax shows a disposition to spread or become complicated with a diffused inflammation of the cellular tissue, blisters have been employed with a view to check the progress of the disease, mitigate the excessive pain, or maturate the pus in the tumour. When the inflammation shows a tendency to spread, it will be often arrested in this way, but in the circumscribed anthrax, the value of blisters is very doubtful. Dr. Physick of Philadelphia, however, states that in the early stages, they abate the burning pain for many hours, and may be repeated for this purpose; but he thinks they rather accelerate than retard mortification in the tumour, when applied in the second stage.

Neither in this country nor in America is the actual or potential cautery much resorted to in the cure of anthrax. Dr. Physick recommends the application of the potassa fusa in preference to the actual cautery in the second stage of anthrax; but though they calm the burning pain after a few hours, they are both inferior in value to that of the treatment by incisions, and should never be preferred to it, unless the pusillanimity of the patient, or some other weighty reason required it.

Constitutional treatment.—When the disease is observed to set in with symptoms of derangement in the digestive apparatus, aperients and tonics are exhibited. Many French surgeons combat the local and general symptoms, at the commencement of the attack, by total abstinence from food, and the administration of diluents and diaphoretics, with general as well as local bleeding in some cases. M. Perez relates some cases of anthrax successfully treated in this way. But it should be borne in mind, that in this class of patients there is oftener a want than an excess of power, and that the disease is more frequent amongst the aged and debilitated, than amongst the young and vigorous. In this country, general bleeding in anthrax, except in a case where the subject is young, plethoric, and robust, is not employed; local bleeding by leeches or cupping is often had recourse to at first; this is followed by poultices, till the incisions are made. In the second and third period, the strength of the patient is supported by a generous diet, with wine, porter, &c. Bark, camphor, æther, ammonia, mineral acids, &c., are administered internally, according to the necessities of the case. Opium is exhibited at every stage, more particularly in the first, to allay pain and procure sleep.

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(*Wm. B. Costello.*)

ANTIMONY, (from *ἀντὶ*, 'against,' and the French word *moine*, 'monk;') a derivation referring to the imprudence of the monks, who, when the substance was first used in medicine, took it in dangerously large doses. *Antimonium*, *stibium*, Lat.; *antimoine*, French; *Spiessglas*, Ger.; *regulus of antimony*, Eng. It exists in nature either in a native or combined state. The antimony of commerce is chiefly derived from the sulphuret. The medicinal preparations of this metal are numerous, and are employed both internally and externally.

The tartarized antimony, or more strictly speaking, the tartrate of antimony and potass, in conjunction with lard, is frequently employed as a counter-irritant. The practice seems to have originated about the year 1773, with Dr. Bradley (Memoirs of the London Medical Society). Dr. Jenner also advocated the use of tartar emetic ointment. He recommended the addition of a small portion of white sugar to prevent it from becoming rancid. It may fail, however, altogether as a counter-irritant if care be not taken to reduce the tartar emetic to an impalpable powder previously to its being incorporated with the lard. Spermaceti may be substituted for the lard. The usual proportions are ʒj of the antimonial, to ℥j or ℥iss of the unctuous substance. A small portion of this ointment may be rubbed in night and morning. It may also be introduced by sprinkling the powder on fresh-made adhesive plaister, and applying it to the skin. The effect produced on the integument varies in degree from simple redness to vesication, and a more or less plentiful eruption of pustules, according to the thinness and susceptibility of the skin, and the duration and strength of the application. The pustules thus raised have some resemblance to those of small-pox, and often spread into a broad and deep ulcer. The ointment is used in most cases where greater permanency of effect is aimed at than can be obtained by vesication with cantharides. A solution of the salt may also be introduced endermically, the cuticle being previously removed by a blister. The external use of antimony is chiefly had recourse to in chronic inflammation of the joints, in deep-seated rheumatic pains, in bronchitis, and in pulmonary affections generally. Tartar emetic is also much employed to depress the vital powers, with a view, through the general relaxation thus produced, to favour the reduction of a luxation, the return of a hernia, the cessation of spasm in the mucous canals, &c.

The only other preparation of antimony employed in surgery is the protochloruret, *the muriat, or butter of antimony.* It is one of the most violent caustics we possess, and is employed occasionally in cauterizing the wounds inflicted by rabid animals, or venomous reptiles, as well as those received in the dissecting-room, in checking fungous growths, in destroying warts, vegetations, and carious bones. It should be kept in well stopped bottles, as it is liable to be much weakened and converted into a yellow oil by absorbing moisture from the atmosphere. It is conveniently applied by means of a roll of lint, which is dipped in the caustic at the moment of use. Its application to cancerous nodules is exempt from the dangers imputed to arsenic, for which it might be advantageously substituted; but it is liable to an objection of another kind, that of spreading beyond the parts to which it has been applied, and being, from the difficulty of limiting its operation, extremely unmanageable.

ANTIPHLOGISTICS (derived from ἀντὶ, *contrary to,* and φλόγωσις, *inflammation*). In its most extended signification, this term is applicable to all measures employed to subdue inflammation.

Under one head, however, would thus be included not only depletive, sedative, refrigerant, and emollient means, together with purgatives, nauseants, and diaphoretics, but remedies of a totally opposite character, whose therapeutic operation in inflammations is secondary or remote, as astringents and counter-irritants, topically applied, and the medicinal substances internally administered under the name of revulsives or contra-stimulants.

In order to avoid confusion, therefore, the term has been restricted to those agents only, which, by effecting an immediate reduction of vital action, whether locally or generally, are directly opposed to the conditions on which the phenomena of inflammation depend.

These may be enumerated, at large, as follows:—General and local abstractions of blood; purgatives, especially the saline; nauseating doses of emetic medicines; reduction of the heat of the body to its natural standard, by means of cooling, diaphoretic, demulcent, and sedative medicines and drinks; cold affusion; warm and tepid baths; regulation of the temperature of the atmosphere; repose both of body and mind; the topical application of cooling lotions, warm fomentations and poultices; and, finally, a diet more or less limited in quantity, carried even, for a time, to total abstinence, and mild as well as easily digestible in quality: all stimulating articles of food and drink being rigorously excluded.

This last is generally denominated the antiphlogistic regimen, and the combination of the whole forms the antiphlogistic system of treatment. (See INFLAMMATION, COUNTER-IRRITANTS, and CONTRA-STIMULANTS.)

(*Henry T. Chapman.*)

ANTRUM OF HIGHMORE, *antre d'Highmore,* Fr.; *Highmorshöle,* Ger. The name of a deep cavity formed in the substance of the superior maxillary bone. The antrum is lined throughout by the Schneiderian membrane, with which it is continuous, through its meatus of communication with the nostrils. (See MAXILLARY SINUS.)

ANUS. The opening by which the rectum terminates, and by which the excrement is eliminated; it is so named from its almost circular shape. The observations proposed to be made in this article will be mainly limited to the affections which implicate the terminal extremity of the alimentary tube. Those which involve the canal itself will be reserved for consideration under the respective heads of HÆMORRHOIDS and RECTUM.

Thus restricting the subject, it is scarcely required for its elucidation, to enter into anatomical details; but that important affection, *anal abscess,* which from its proximity is naturally associated with our present subject, forbids that we should entirely dispense with them.

The anal aperture is a rugous slit, situated, in a direction from before backwards, midway between the tuberosities of the ischia, and is hidden from view by the approximation of the glutei maximi muscles. To terminate at this point, the rectum advances from the sacrum, and, according to the sex of the subject, passes under the bladder and prostate gland, or under the vagina, where it turns downwards, and a little backwards, to offer the aperture in question. Its extremity is provided with two muscles, which, from their position, are termed *sphincters,* and one of which serves also to maintain it in its situation. One of these, the *internal sphincter,* is in direct contact with the mucous lining of the gut, and is, indeed, nothing more than an amplification of the circular fibres which exist in the rest of its extent, and with which its upper margin is continuous. On introducing the finger into the gut, as far as the second joint, the defined margin of this circular band of muscular fibres may be easily felt through the mucous membrane; and by the same mode of examination, it will be ascertained that its calibre diminishes as it descends from the bladder or prostate gland to the anus.

It is stated in the American Cyclopædia of Medicine[1], on the authority of Dr. Horner, the Professor of Anatomy in the University of Pennsylvania, that the external or longitudinal fibres of the gut do not insensibly disappear on their arrival at the internal sphincter; but, on the contrary, that the major part of them are continued on the outside of the sphincter, assume a tendinous appearance as they descend, and are accumulated into numerous fasciculi, which, passing under its inferior margin, ascend on the internal surface of the sphincter (but having a less intimate connexion with it than with the mucous membrane), and, finally, after again becoming obviously muscular, are inserted into the mucous lining of the gut as high as an inch and a half or two inches above the inferior margin of the sphincter. We have endeavoured to verify these observations of the American professor in two recent dissections, but we confess that we have hitherto failed to trace the reflection of the fasciculi from without inwards, and, consequently, their muscular termination in the mucous membrane. Should, however, the fact turn out to be as he has laid it down, its influence in producing prolapses of the rectum would be so apparent, and that affection so readily explained, that it merits the institution of more dissections than we have been able to make; and it is probable that in the article Rectum, we may be prepared to admit or disprove the assertion.

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[1] Part VI. p. 81.

The lower end of the gut thus tapered and provided with a thickened muscular coat, is received into the upper concave surface of a long elliptical muscle, in the centre of which there is a longitudinal slit. This is the *cutaneous* or *external sphincter*, a muscle which accomplishes the fixation of the end of the tube, by having its posterior angle attached to the point of the coccyx, and its anterior angle to that tendinous point in the perineum which is common to the sphincter behind, the acceleratores urinæ in front, the transversi perinei on each side, and the anterior fibres of the levatores ani above. In the female, its anterior angle is attached to the sphincter vaginæ.

The lower edge of the internal sphincter is received on the concave surface of the cutaneous sphincter, in such manner that the latter by the upper part of its circumference embraces the outside of the former muscle, and by the lower blocks up the aperture to the gut, there being nearly half an inch between the slit and the point of contact of the two sphincters, and which point of contact is marked by a distinct cellular line.

The rectum, with the bladder and prostate gland above it, is confined in the cavity of the pelvis, and the sphincter externus is excluded from it by a broad flat muscular septum, the pelvic surface of which is concave, the perineal convex, which, with a slight interruption to its origin at the symphysis pubis, is fixed to so much of the parietes of the pelvis as are anterior to the spinous processes of the ischia (being attached to the pelvic surface of the bodies of the pubis, and to the aponeuroses covering the obturatores interni, and the flat surfaces of the ischia which correspond to the acetabula) and behind, and on the median line, it is attached to, and supported by, the point of the coccyx. The narrow space which exists on each side the coccyx, between its edge and the sacro-sciatic ligament, is filled up by the ischio-coccygeus muscle. The anterior part of this muscular platform presents an infundibuliform opening lodging the prostate gland and giving exit to the membranous portion of the urethra; and, below this opening, another much larger, through which the extremity of the rectum is pushed in such a manner that the fibres of the edge of the opening intermingle with those of the sphincter ani. So much of the rectum as is beneath the bladder is adherent to a cellular line which extends backwards to the os coccygis, and which makes the division of this septum when it is described as consisting of two muscles, denominated *levatores ani.*

At the line which indicates the fixed attachment of the levatores ani, the pelvic fascia splits into three laminæ. Between the first two (counting from the cavity of the pelvis) is contained the muscles just mentioned, to which the aponeuroses are firmly adherent. The pelvic lamina quits the levatores ani, and attains anteriorly the neck of the bladder, where, by reason of its being pierced by the dorsal vein of the penis, it forms the two anterior ligaments of the bladder; more outwardly, the sides of the prostate gland and bladder, by an upward reflexion constituting the lateral ligaments of the latter organ; and, still more posteriorly, the sides of the rectum. The perineal lamina descends on the outside of the levatores ani degenerating in its progress so as to be scarcely perceptible on the posterior part of the rectum; anteriorly, it is confounded with the attenuated border of the triangular ligament of the urethra, is attached to, or rather contributes to form, the tendinous centre of the perineum, and glides behind or beneath the transversus perinei muscle to constitute the superficial fascia of the perineum; and, in its middle portion, it passes from the outer border of the external sphincter to be lost in the superficial fascia covering the buttocks.

The third or exterior lamina of the pelvic fascia is of a dense and resisting character, and contains within its substance the pudic and hæmorrhoidal vessels. It covers the perineal surfaces of the obturatores interni, binding those muscles against the obturator ligaments. Posteriorly, and on either side, it is received into the great sacro-sciatic ligaments; and more forward it becomes confounded with that portion of the preceding layer which passes on the external surface of the gluteus maximus. Anteriorly, it occupies the pubic arch, is attached to the rami of the pubis and ischia (constituting the greater portion of the thickness of the triangular ligament) assists in forming the central tendon of the perineum in front of the rectum and above the transversus perinei, and, at the posterior border of these muscles, unites with the perineal fasciæ of the levatores ani, where they are proceeding to form the superficial fascia of the perineum, in such a manner that the posterior border of each transversus perinei is lodged in the groove formed by the union of these two fasciæ, and it is this union which effectually excludes the anal from the urethral portion of the perineum.

The fascia of the obturator internus, and the fascia of the levator ani, form, by their union above and their separation below, a triangular space measuring rather better than an inch from side to side, and an inch and three quarters from before backwards. This space, on either side, is completely filled with adipose tissue supported by cellular bands, which are produced principally from the external face of the fascia of the levatores; and it is entirely closed in below by the overlapping of the gluteus maximus.

By the arrangement, the union and the attachment of these several fasciæ, it will be seen that not only is the anus fixed in its position, but that the connexion between the extremity of the gut and the urinary organs is so intimate and complete as to exclude the possibility of their separation; that, on each side of the rectum, there is a recess, having aponeurotic parietes in every direction, and still more completely closed by the union and degeneration of its fascial walls into the superficial fascia covering that muscle, filled with a material sufficiently dense to support that organ, yet so yielding as to admit of its volume being augmented; that in front of the rectum there is another but smaller recess bounded by the transversus perinei below, the deep fascia above, and by the line of union of the deep with the superficial behind; and, that the surface of the sphincter externus is not implicated with any other fasciæ, but is in direct contact with the skin.

The skin advancing from the commutual sides of the glutei becomes darker in colour, and finer, and more extensible in structure, as it approaches the anus, where it is gathered into plaits which soon vanish as they radiate from this centre. It is furnished with follicles, small but numerous, especially at the verge, which secrete the unctuous product that always bathes these parts, and where the nates rub against each other the skin is provided with a quantity of soft hairs.

The vessels which supply the anus communicate freely with those which are distributed to the intestine itself, and like them they form a plexus around the organ. The veins, especially, are reticulated in the submucous tissue, and are very obvious within and about the verge when the circulation is retarded. The arteries which interest us at present are a few branches, irregular in their number, which proceed from the *internal pudic* immediately on its entrance into the triangular space on the side of the rectum. These, under the name of the external hæmorrhoidal artery, supply the integuments and external sphincter, and, by ascending ramifications, they inosculate with others which proceed from the middle or lateral hæmorrhoidal.

Accompanying the external hæmorrhoidal artery are the venæ comites, which terminate in the external pudic vein, but the transit of the blood is mainly through the plexus formed by the middle and superior hæmorrhoidal veins, so that in returning to the heart it takes the route of the portal system.

This part is supplied with nerves of animal life, and with nerves of organic life; the former are derived from the sacral plexus through the medium, principally, of the inferior branch of the pudic nerve; the latter proceed from the hypogastric plexus of the great sympathetic nerve. In the distribution of both these classes of nerves the bladder and the rectum receive their supply in common, thereby associating them in a disordered as well as in a healthy state, and affording us a clue to the explanation of phenomena that present themselves when either organ is disturbed and which otherwise would be unintelligible.

ANAL ABSCESS.

That abscess in the neighbourhood of the anus should be of frequent occurrence, might be anticipated from a contemplation of the functions to be performed and the organization provided for their accomplishment. The volume of the rectum is ever varying, and the artificial habits of civilized life cause it to be the seat of stercoral accumulations, which become irritative, not only by retarding the blood in its passage to the heart, but, also, by their mechanical influence on the intestine and the adjacent structures, the nature of which is such as to favour, to the greatest extent, the formation and the accumulation of pus. The circumstances under which the gut is shaped and fixed, render it liable to occasional perforation; for foreign bodies which have been taken into the stomach will sometimes be arrested here, after having innocuously traversed the rest of the tube, and, by perforating, if the body be spiculated, or by ulceration if it be obtuse, become lodged in the cellular tissue which occupies the ischio-rectal space; and in like manner, also, is abscess produced, by the careless or violent introduction of foreign bodies, such as glyster-pipes, bougies, &c., *per anum*. The parts between the ischia are, from their situation, exposed to injury from kicks, falls, &c., and force so applied frequently produces an abscess of a grave description. Tumours, originating in a stasis of the blood in the veins of the anus, and oftentimes becoming the sources of abscesses, do not depend entirely on the accumulation of hardened fæces. The chief part of the blood passes from the veins of this organ into the inferior mesenteric vein, and whatever may arrest or retard the circulation in the portal system, whether it be the altered structure of the liver, pancreas, or mesenteric glands, the blood will be dammed up in the anal veins, thus constituting irritative tumours. (See Hæmorrhoids.)

But it is not so much to the causes, as to the nature, locality, and consequences of abscesses about the anus that our attention will be directed; the general doctrine of their formation having been treated in the article Abscess.

The existence of so much cellular tissue, bolstering up the sides of the extremity of the rectum, is favourable to the production of phlegmonous or carbunculous abscesses; and the abscess will be the one or the other, according to the tone or atony of the organism, or as the action may be moderate and continuous, or excessive and sudden.

The situation in which they prevail are the ischio-rectal spaces between the levator ani and obturator internus muscles; between the two laminæ of the pelvic fascia which embrace the levator ani, and consequently involving the muscle itself; in front of the rectum and above the transversus perinei muscle; and, lastly, between the margin of the internal and the superior surface of the external sphincter muscles themselves.

1. *Phlegmonous Abscess.*—Abscesses of this description occur in all the situations we have just indicated, and, in most instances, it is by no means easy to determine the cause which has produced them. Whether the inflammatory action which precedes and is coincident with their appearance be established by the local irritation, or, whether the febrile excitement relieve itself by the formation of pus in these parts, as it often does in others, may admit of doubt, but affects not the question of functional disturbance or the means of relief.

The usual indications of a phlegmonous abscess, redness and swelling of the part, are not always, in the first instance, to be observed; and we are often able to detect the existence of matter before any external sign is apparent. To the general disturbance of the circulation heretofore described (see Abscess) are added phenomena which depend for their production on the peculiar functions of the neighbouring organs.

When the matter is deposited between the embracing laminæ of the levator ani, the tumour formed by it encroaches on the rectum and diminishes its capacity, offering a physical impediment to the expulsion of the fæces; the performance of which act, during the inflammatory stage which preceded the elimination of pus, was attended with aggravated suffering, being, now that the canal is narrowed, accompanied by such unbearable torments that every effort which the will can make is employed to resist the impulse to evacuate the bowels. The bladder, too, becomes implicated to a greater or less extent. Commencing with a simple, but often repeated desire to urinate, its sympathy augments as the disease advances; dribbling of the urine is superadded to the desire to urinate; and complete retention occurs when the tumour attains a large size. This last phenomenon, however, does not so frequently occur when the matter is situated laterally to the rectum, as it does when the abscess is formed in front of that organ.

All this functional disturbance may be produced without any external indications of the nature of the affection; or, if there be any, they are of so uncertain a character as not to be depended on. The finger, and the finger alone, introduced per anum, will announce to us the condition of parts; a fact which enforces the necessity of instituting this mode of investigation at the outset of any affection which may interfere with the functions of the bladder or rectum. This is still more impressed on us by a consideration of the effect of matter, so pent up, on the rectum itself. On the one hand, we have a fascia of some density, supported on its outer side by a cushion of cellular tissue, which prevents the extension of the walls of the abscess in that direction, save by the successive agglutination of the tissues; and, on the other, we have the rectum readily yielding towards its cavity and opposing little resistance to the extension of the abscess on that side. It, therefore, becomes a point of deep importance to make an exit for the pus by bold and prompt incisions through the integuments; everting the gluteus maximus, and cutting by the side of the rectum so as to penetrate into the ischio-rectal space. If this procedure be deferred until the fluctuation can be appreciated externally, one of two things will happen; either the abscess will open into the rectum, or that gut will be so thinned as to expose its mucous coat, and thus render unavoidable its division so as to form one cavity of the abscess and the rectum. (See Fistula.)

2. Phlegmonous abscess occurs, also, in the ischio-rectal space, on the outside of the fascia of the levator ani muscle; but it is of a less alarming character as respects the implication of the rectum and bladder in this, than in the former, situation, though equally so as regards its ultimate effects. The nature of the tissue contained in it favours the accumulation of pus when once it has been secreted; but, as it is not bound so closely to the rectum and bladder as, in fact, the levator ani and its fasciæ intervene between the abscess and those organs, their functions are not necessarily impaired at the commencement of the deposition. The same urgency, however, exists for the speedy and complete opening of the abscess. By neglecting to open it, the cavity rapidly extends itself, and an immense reservoir of pus is established which is not always restricted to one side; but, on the contrary, sometimes passes behind the rectum to the opposite ischio-rectal space; and instances are not wanting in which the rectum has been completely dissected out and left pendulous in a pool of pus.

The matter accumulates more upwards than downwards by reason of the impediment offered by the union of the fascia of the levator ani with that of the obturator internus, at the line where they commence their joint descent, behind the transversus perinei muscle, on the surface of the gluteus maximus. Hence, by being long pent up, the matter separates the fibres of the levator ani and the muscular coat of the rectum; laying bare the mucous membrane, as in the case before mentioned, and rendering the same division of parts necessary. The arrangement of the fascia on the gluteus maximus explains the reason of the peculiar formation of the tumour. Though circumscribed, as in other parts, it is not defined, and its base is lost in the muscle through which it is felt.

It has been a question on which surgeons have been divided in opinion, whether the operation should cease on the free liberation of the matter, or be continued to the division of the gut. It appears to us that the question admits of no dispute; for, if the rectum be not denuded, and a full and fair incision be made into the abscess, the cavity will, in the majority of cases, be filled up without the intervention of a severe, and, in that case, unnecessary operation. Nay, should the mucous membrane be laid bare, is it not in opposition to every principle of surgery to perform an operation which would entail the necessity of cramming extraneous, and consequently, irritating materials into parts already irritated to an unnatural degree? For it must be borne in mind, that to carry out the principle of such an operation, the walls of the cavity, both incised and purulent, must be kept separate to ensure its granulating from its deepest surface; and we know that where, as in fistula, the inflammation that prevails in the cavity has assumed a chronic form, the introduction,—the necessary introduction,—of a foreign body frequently lights up great constitutional as well as local irritation. But here there is nothing chronic; the plastic operations of nature are in their greatest state of activity, and to interfere with them is to thwart their efforts by re-exciting a tumultuous action which would destroy the newly formed granulations. And here the questions arise how much of the reparation are we to leave to a natural process? and how much are we to take into our own hands? We must either make the connexion between the gut and the abscess at the greatest depth of the latter, or there is some point of limitation. Seeing that the abscess sometimes extends as high as the line of union between the two fasciæ which form the walls of the recess, in other words, as high as the origin of the levator ani, it is obvious that we cannot make the incision there; and, if we stop short of that, it is difficult to conceive the soundness of a doctrine which does not equally apply to the treatment of the upper and to that of the lower part of a cavity.

It appears to be a more discreet proceeding to limit our endeavours to a decided and ample liberation of the contents of an abscess (for it is the feeble and imperfect opening which usually is followed by these fistulous drains) and, without attempting to inquire into the state of the gut, to suffer the patient to remain tranquil that the disturbance of the system may subside, and the parts be restored to a degree of composure. Whether an operation may ultimately be necessary, or whether it may be altogether dispensed with, there is this great advantage gained by delay, that a chronic will have supplied an acute action, and the dressings and passage of the fæces will be more readily tolerated; while, further, a considerable portion of the cavity will be filled up and the point for perforation accurately pointed out.

We would not exempt from this condemnation, notwithstanding the high authority of its proposer, the plan recommended by Velpeau of opening the abscess, when it involves the levator ani, from the interior of the rectum by means of a probe-pointed bistouri, so guarded as to avoid wounding the anus and lower part of the gut. It is difficult to ensure that the incision shall extend to the deepest part of the abscess, and, if it do not, we only make an aperture into a cavity into which the fæces will readily make their way; and even if we accomplish the full division of the parietes of the abscess, the stercoraceous matter would yet insinuate itself between the edges of the incision, and thus, by fomenting an inflammatory action and the burrowing of pus render ultimately necessary a complete division of the sphincters. It is possible that in a few solitary cases the restorative process may be carried, by these means, to a successful issue; but it appears to us that they will not justify the substitution of such a plan for one which is far more safe and less likely, if it be properly performed, to entail future annoyance on the patient.

We say, "properly performed," inasmuch as the chief cause of incomplete success attending the operation of opening from below, arises from the system of puncturing rather than incising the parts; thereby affording a facility for the lodgement of pus, the retention of which carries on the work of devastation in the same way as does the introduction of fæcal matter in the operation advocated by Velpeau.

3. Phlegmonous abscess is sometimes situated in front of the rectum. When so situated, the bladder suffers more than the rectum, for the tumour presses directly beneath the prostate gland, and the membranous portion of the urethra, against which it is principally directed by reason of its being confined by the deep fascia of the perineum above, the transversus perinei and superficial fascia below, and the union of the two fasciæ behind. By this union of the fasciæ the tumour is prevented encroaching on the rectum, and, by the same cause, its accumulation is directed upwards and forwards to the urethra. There is some pain in the act of defecation, but not of so aggravated a kind as when the matter is situated on the side of the gut; but the retention of urine by the occlusion of the urethra arrives more speedily, and is more complete than in the former instance.

An incision, like unto the first in the operation of lithotomy, but not extending so far back, should be made in the perineum, and carried into the space between the accelerator urinæ and erector penis, dividing the transversus perinei so that the pus may be entirely emancipated. This should be done so soon as the bladder betrays distress; for, by delaying it, there is considerable risk that the bladder will be relieved by a rupture of the urethra, its contents being poured forth into the perineum and scrotum.

An elderly gentleman, who has been some time under our observation, has suffered for the last thirty or forty years under an affliction, the consequence of such negligence. As far as can be gathered from him he was suddenly, and without apparent cause, seized with violent pain, accompanied with a sense of weight in the perineum; his bladder became irritable, and, in a short time, his urine was suppressed. The perineum in front of the anus was hard and tumid, and leeches were liberally applied. He has no recollection of being much incommoded in passing his motions, but he does recollect that his intolerable agony was assuaged on obeying a simultaneous desire to urinate and evacuate his rectum. The urine he describes as being offensively strong, and from his rectum had passed a considerable quantity of matter. From this time his urine flowed freely, but pus continued to drain from his anus and to pass with his stools, and, after the lapse of a considerable period, (he cannot say how long) the major part of his urine passed, per anum, though some of it continued to be discharged easily through the natural passage. Subsequently to this, whenever he took laxative medicines, a portion of his fæces passed through the urethra, and in this condition he continues to the present day. At all times a quantity of urine is discharged when he evacuates his bowels, and, whenever they have been acted on, his urine is always turbid with fæculent matter, and sometimes small portions of excrement temporarily stop up the urethra.

In the foregoing case it is probable that the urethra had been denuded before the bursting of the abscess into the rectum, so as not to be able to take on the granulating process by reason of which the cavity of the abscess was incapable of being closed, and a fistula was established in its stead. This must have been accomplished before the imperforate end of the canal was absorbed, or otherwise there would have been an infiltration of the perineum, which there was not; but the water steadily proceeded then, as it does now, from one organ to the other. A knife, employed in the early stage of the deposition, would have saved this man nearly half a century of annoyance and many years of suffering.

4. In the immediate region of the anus abscesses frequently occur which, though of the same nature, are, when contrasted with those enumerated in the preceding sections, of trivial import.

Oftentimes they are situated in the integuments, and attention is drawn to them by an uneasy itching sensation, when the finger detects a hard roundish pimple, which sometimes disappears of itself, but at others continues; although, becoming softer, no further notice is taken of it until an unusual moistness of the parts, or the tinged condition of the linen induces the patient to solicit surgical examination. There is then found, on separating the nates, a very small aperture admitting frequently of only an eye probe, which may be passed under the skin, and will ascend with it within the verge of the anus, where it most commonly ends in a *cul de sac*. If the aperture cannot be readily found, by pressing the ball of the finger around the margin of the anus, we may succeed in disengaging a portion of the discharge which will thus betray its locality. In the majority of cases, frequent ablution, alone or followed by an application of a solution of the sulphate of zinc, will suffice to cure them without the formality of an operation: and even when they do open into the canal, they frequently disappear of themselves, though they labour under the disadvantage of receiving into them the secretions of the gut.

When the tubercle is somewhat larger, and by its size and hardness, is exposed to attrition with the opposite buttock, it is well to transfix them at once, that by dividing them the engorged tissue may relieve itself and suppuration be forestalled.

These hardened tubercles often occupy the cellular line which is interposed between the two sphincters. They may originate in a point of congestion in the cellular substance, but it is more frequently from a consolidated hæmorrhoid taking on the suppurative action that abscesses of this description spring. These should never be suffered to remain unopened, since, should they open and discharge themselves into the lower part of the rectum, the matter would still extend itself to the integument; and, indeed, it is by this means that they constitute the main source of ordinary fistula. (See FISTULA.)

5. Considering the ravages which these abscesses effect, it becomes an imperious duty of the surgeon to endeavour, in the first instance, to prevent their formation by a prompt, judicious, and untiring application of those means which are calculated to relieve total congestion, and to reinstate the balance of the circulation; and, in the second, when these measures have failed, to modify them in such manner as will lead to the next most favourable termination.

There is generally no want of power in those who are thus attacked, and, therefore, that universal feverishness of action which attends tonic congestion, in parts more yielding and less embarrassed, is, in these cases, of a most exalted and positive character, and must be met with corresponding energy by general and local treatment apportioned to the exigencies of the patient. It may not, in some instances, be possible to prevent the deposition of pus, but it is possible to modify the local as well as general activity, to limit the quantity of pus, when once formed, and to restrict its evil effects; and, above all, to soothe the irritation which reacts on the cause from which it sprung.

General bleeding at the onset; a liberal and often-repeated application of leeches to the parts around the anus and the pubis; puncturing the hæmorrhoidal veins, should any be distended; applications of the hip-bath, supplying, by a tube, hot water, so that when the patient emerges from the bath the water may be hotter than when he was first immersed in it; fomenting the perineum and genitals in the intervals, will frequently recompense the trouble they occasion by restoring the integrity of the attacked structure. But even if they do not effect this, they will enable the patient to urinate, to evacuate his bowels by the aid of some unstimulating laxative, without torture; and, by stimulating the vessels of the skin, blood will be retained at the surface of the body which would otherwise be determined internally.

When it is suspected that the first object has failed, and that pus is formed, it is yet competent to the surgeon to keep the action within just bounds, by the occasional and modified use of some of these means, until such time as matter is unequivocally manifested, and manual aid demanded.

6. *Carbunculous abscess.*—The cellular tissue occupying the ischio-rectal spaces, though admirably adapted for the formation and extension of phlegmonous abscesses under ordinary circumstances, is not sufficiently organized, in many subjects, to resist a sudden influx of blood; so that the arterial impulse which, in one person, will merely congest the part preparatory to the formation of abscess, will, in another, destroy the vitality of the structure.

External force, or the introduction of a foreign body, will effect this without reference to the tone or atony of the parts; but, whenever it is idiopathic, it occurs in subjects in whom the vital force is feeble, whether it be from original delicacy of organization, from long-indulged habits of intemperance, or from protracted suffering.

When it arises from the first cause, a tumultuous action is set up in the system, such as obtains in phlegmonous abscess; and it is therefore necessary, in every case in which the tissues about the rectum are concerned, that an investigation be made, whether external violence, or the introduction of a foreign body be implicated in its production; because, to pursue, in these cases, the energetic treatment which phlegmonous abscess demands, would speedily reduce the body to that state of atony which prevails in idiopathic carbunculous abscess.

Forewarned that one of these two accidents has occurred, it is advisable to husband the strength of the patient by avoiding unnecessary depletion; yet, at the same time, it must be borne in mind, that, if the arterial impulse be not tempered, the tissues adjoining the part which has already been destroyed, will lose their vitality in the same manner, from the inordinate ingress of blood. The extent to which these measures may be carried, and the point at which the surgeon should pause and institute a treatment exactly in opposition to the former, must be entirely a matter of judgment, without the exercise of which, all rules, however speciously paraded, will be unavailing.

The idiopathic carbunculous abscess generally supervenes on a long-continued illness, in which the body has, either from the wearing-out nature of the affection, or the treatment pursued, been enfeebled in its powers.

When the arterial excitement consequent on accidental carbunculous abscess is allayed, and the devastation arrested, it will be in the same state, and subject to the same management as the idiopathic, with this difference in favour of the former, that, as there is a greater vital force at the commencement of the disease, there is a greater chance that the plastic operations of nature may prove successful.

The affection is usually limited to one side. The bladder and rectum sustain but little disturbance, when contrasted with the sufferings of which they are the seat in phlegmonous abscess. The tumour has no defined limits, vanishing insensibly into the buttock on one side, and laterally to the rectum on the other. It is quaggy to the touch, to which it communicates but uncertain evidences of fluctuation. The skin becomes livid and assumes an erysipelatous character; small orifices appear on it, through which a probe may be passed to almost an indefinite extent, and from which a small quantity of unhealthy pus exudes; the skin between some of these orifices is absorbed, by which means they coalesce and form larger openings, and thus the interior of the cavity is displayed. This is occupied by a mass resembling sodden whity-brown paper, infiltrated with pus; and it is this mass which nature has to detach from the living structure.

Such carbunculous abscesses appear in other parts of the body, but under more favourable circumstances, inasmuch as there the adjacent structures are vascular, and therefore competent to the speedy absorption of the living surface in contact with the dead mass. In the ischio-rectal space we have fascial walls slenderly vitalized, and in which the action, necessary to disunite them from the gangrenous contents, is almost sufficient to effect their own destruction. If, in addition to this, we take into account the pressure which is made on the living surface by the binding effects of the skin (a pressure which inevitably disorganizes the small vessels distributed on it), we can understand why the amount of labour thrown upon nature is so great, and why the constitution should give way under the attempt at its performance, when the process is unassisted by surgical means.

So soon as the finger can appreciate the soft quaggy condition of the tumour, it should be immediately opened, parallel to the anus, from one extremity to the other; and, after the application of the usual anodyne fomentation, the nates should be placed in a poultice of boiled linseed meal and lard, thick in quantity but rather thin in quality; and the poultice and nates should be placed on an annular bolster (similar to that which a milk-maid employs to support the pail on her head), that the pus and shreds of decomposed cellular tissue may descend into the poultice by their own gravitation.

When by such a liberation and the employment of such means, the local irritability has subsided, an assisting impulse may be given to the local action by adding muriate of ammonia, or spirits of wine, or of turpentine, to the fomentation, and by substituting the grounds of a beer-barrel for water in the poultice.

At the same time, the powers of the system must be aided by a liberal administration of permanent stimuli, as animal food, quinine, porter, and wine; and, if the prostration of strength be great, and the danger urgent, transient stimuli, such as opium, brandy, æther, and camphor, must be resorted to to uphold the system, until the permanent stimuli, by acting upon it, shall render their further employment unnecessary.

Nevertheless, it will often happen, in the cases of persons who have resided long in large towns, that, however judiciously they may have been treated, though their lives may be saved, they will require a protracted residence in the country, with all the attendant circumstances of comfort and generous living, to complete the cure and restore them to strength.

EXCRESCENCES.

Tumours, such as are met with in other parts of the body, are developed in the neighbourhood of the anus, being sometimes within, at others upon, but more frequently below, the verge.

Immediately within the verge of the anus, but more properly belonging to the rectum, there are often produced *polypous elongations of the mucous membrane*, which have a soft, spongy appearance. These, which at times have a broad, and at others a pedicular attachment, are not always apparent until the patient makes great expulsive efforts; but they are easily detected by the finger, and not unfrequently they emerge, prior to the evolution of the fæces. They rarely demand manual aid for their removal. A solution of sulphate of zinc, or the introduction of a piece of a candle, smeared with an ointment containing powdered galls, or the application of a solution of nitrate of silver, when the tumours are extruded, will suffice for their dispersion, and oftentimes they are detached of themselves.

Warts are found on the circumference of the anus, and are productive of great inconvenience; the irritation they excite being sometimes so great as to affect the general health. They are not always confined to the circumference, but extend occasionally to some distance within the anus. By touching them occasionally with any of the strong acids they will fall off, but it is more advisable, and a much readier mode, to snip them off at once.

Schirrous, encysted, and fungoid tumours occur on, and in the neighbourhood of, these parts; but they offer no peculiarity to demand a special consideration in this place.

Condylomatous tumours occupy the skin adjoining the anus, and appear to be produced by the extension of the irritating fluids from the genitals. They have the same appearance as they present in other parts, save that they are more flattened by the rubbing of the nates, and they yield to the same mode of treatment.

RELAXATION OF THE ANUS.

The anus, instead of presenting a corrugated line deeply situated between the buttocks, is sometimes totally effaced; and the faces of the buttocks glide without interruption into the gut, so as to represent an inverted funnel; or the margin of the dilated aperture is loose and flabby, and hangs somewhat downwards. In the former case the sphincter has lost a considerable portion of its tonicity, but its functional power is not altogether destroyed; in the latter, its utility as a grasping muscle is entirely lost.

Whatever has a tendency to impair its association with the nervous system will necessarily produce relaxation of the sphincter, and in affections of an exhausting character, the broad shoulder of a glyster-pipe will pass without impediment into the rectum; but this condition being merely a symptom of some other affection, will not require further notice. Neither is there any practical utility to be derived from dwelling on that dilated condition which is produced by the revolting practices of those wretched monsters, who, setting at nought the impulses of nature, place themselves out of the pale of society.

A descent of the rectum or hæmorrhoidal and other tumours by their continued pressure within the sphincter will impair, and perhaps destroy its contractility, so that when the cause is removed, there yet remains a difficulty in retaining the fæces. A long continued use of astringent lotions, such as decoction of oak-bark with alum, and dashing cold water on the part, may possibly restore the tone of the muscle; and, by pinching up and cutting off several of the folds about the verge, the diameter of the orifice may be so far diminished by their cicatrization as to secure a certain degree of comfort to the patient.

SPASM OF THE ANUS.

"It has often occurred to me to remark, and has been observed by others," says Copeland, "that cases, which are called strictures of the urethra, and of the œsophagus, admit of more easy, more certain, and quicker relief, by the use of the bougie, than they could possibly do if the structure of the membrane of those canals were disturbed, as in cases of real and permanent stricture. Such diseases have usually been called spasmodic stricture. If the other canals of the body are affected, and their functions deranged by the mere spasm of their muscular fibres, it seems yet more probable that the rectum, surrounded at its extremity by a very powerful muscle, should be liable to a similar affection[1]."

Spasm of the anus, it seems probable, is mostly the consequence of some preceding morbid irritation, situated either in the gut itself, or in some of the organs with which it is interested; and it consequently ceases when that irritation has been removed. Such is the case when the urinary or genital organs are excited; for though the sphincters (especially the external one) always participate more or less in the disturbance of those organs, their spasmodic action ceases when the others have regained their quiescence.

There appears, however, to be produced, sometimes by an insidious and long-continued irritation in the intestine, or by the degrading broodings of a licentious mind, a spasmodic condition of the extremity of the rectum, which becomes a cause of its own continuance, by reason of the inflammation which has been set up in the parts, and which their state of activity will not allow to subside. In this condition, when by removing the cause alone we do not remove the effect, the affection merits a place in a dissertation on the diseases of the anus.

This affection, at its commencement, is announced by a deep-seated uneasy grasping sensation, and a feeling as though the anus were drawn upwards. Great restlessness prevails, and the patient either hurries about the room rubbing the part forcibly with his finger, or sits with it pressed on the edge of his chair. He flies to the water-closet, and makes ineffectual attempts to empty his bowels, and then he begins to alternate the former means again, until the spasm gives way, and a stool, generally of a costive character, is obtained.

In a short time it acquires a character of periodicity—a character which, in its greatest state of aggravation, it never entirely loses—and it generally makes its attack at night, awakening the patient from his sleep, or preventing sleep altogether in the early part of the night. When this periodicity is established, there comes on a smarting pain, as though the anus had been excoriated by excessive purgation, and this pain becomes more and more of a burning character, until it is intolerable.

On examining the parts, the sphincter is found powerfully contracted, so much so, that it is only with much difficulty and torment that a small bougie can be made to penetrate. When, by appropriate agents, the spasm is so far overcome as to permit the introduction of the little finger, great heat is found to prevail in the interior, and the internal sphincter as well as the external is felt tightly grasping the finger.

The inflammatory congestion of a part possessing such strong and numerous sympathies, explains at once the fearful symptoms which attend it. The language of the patient appears to be exaggerated, and when he compares the sensation to that produced by the lodgement of a red-hot iron in the gut, or to the tearing it out with fish-hooks, it may seem strange that such should be the case, more *after* than *at* the time of the expulsion of the fæces. But we must remember, that it is only to the most urgent calls of nature that he attends, and that the solid fæces in their descent, a descent accomplished by violent abdominal contraction, stun or blunt the energy of the nerves, and so effect their exit with comparatively little pain. When, however, they are expelled, re-action takes place, the nerves re-acquire their sensibility, which is for a time exalted proportionally to its previous depression, and, until this state subsides, the paroxysm endures.

The fæces are not discharged regularly; they are sometimes in flattened pieces, like tamarind stones, at others they are in strips like casement-lead issuing from a mill; and, occasionally there bursts out suddenly a mass of fæces, fluid, and mucus. The difficulty and distress attending this operation is shortly followed by intense suffering, "Perhaps there is no disease that the human frame is subject to which is more painful: the involuntary contractions of the sphincter are compared to the pains of labour; they frequently come on immediately, but more usually about an hour or more after each evacuation, and sometimes continue till the succeeding one. In some instances, the complaint goes on to produce suppuration and consequent fistula. Sometimes the irritation is propagated to the neck of the bladder, and produces a retention of, or impediment to, the urine. I have seen it in two cases extend up the canal, and give rise to attacks of violent colic, and an increased secretion from the whole inner membrane of the gut, so that an evacuation of mucous cylinders, of the size of the part of the canal where they are formed, or of detached pieces of mucus, are seen mixed with the fæces[1]." The act of coughing produces the greatest distress, and the expulsion of wind immediately brings on a paroxysm almost as violent as that attending the dejection of the fæces. To ride on horseback is impossible, and even the sitting posture can be endured only by the patient's twisting himself so as to press only on one buttock.

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[1] Copeland's Observations, p. 45, ed. 3.

[1] Copeland, Op. cit. p. 51.

To relieve this affection, Mr. Copeland recommends the use of opium and the introduction of bougies, observing that "when the muscle has been dilated and extended several times, it more easily yields to the stimulus of the fæces, and no longer affords the strong impediment which it had heretofore done; or its fibres, which had not perhaps a contemporary action, assume a more regular dilatation or contraction, and the symptoms subside[1]." And he appears to found this recommendation on the well-known susceptibility of the sphincters to be dilated by artificial means, even to the extent of admitting the whole hand into the rectum.

Deferring much to the opinion of this experienced surgeon, we yet apprehend, that, in the aggravated form of the disease, the introduction of a bougie is unscientific in principle and inapplicable in practice.

We assent to the proposition in the "earlier and lesser degrees of inconvenience which it produces;" in that stage, in fact, on which inflammation supervenes, and in which there is spasm, and spasm only, produced by some irritant. The patient even discovers of himself, without knowing the reason, the power which pressure exercises over the disease; and therefore he rubs his fundament, or squeezes it on the edge of a chair until he obtains relief; and if the end of a bougie be introduced at such a time within the spasmed sphincter, the muscle will soon expend its energy on that instrument. If then the wider part of the instrument be introduced, the natural tone of the muscle may be so far exhausted as to render it unlikely it will so soon resume its spasmodic action; and time will therefore be afforded for the institution of such measures as will remove not only the offending matter, but the condition of the organs which caused its detention, and thereby the intestines may be solicited to resume a regular action.

But it is very different when congestion and inflammation have supervened. Pressure, instead of affording relief, produces great pain; the patient not only does not rub the part, but he is frightened at the sight of his surgeon lest he should touch it; and it requires a strong exercise of the mind on the part of the sufferer to refrain from springing off, when the surgeon's finger approaches his anus.

Here the spasm, originally the cause, is now the consequence, of inflammation; and the adoption of means which were suitable before its supervention, can only tend to increase it, while it is the surgeon's aim to diminish it in the soonest possible time.

Yet, in attacking the inflammation, it is to be borne in mind that we are dealing only with an effect; and we must not lose sight of the obligation to attempt at the same time the removal of the first cause.

The surest and readiest mode of producing present relief, and of placing the patient in a favourable situation for the administration of those means which will restore the integrity of the digestive apparatus, is by dividing the sphincter on each side in the manner pursued in congenital occlusion of the anus. Not only is the sphincter rendered powerless, but the vessels of the congested tissues are emptied of their blood by these incisions, and the local tranquillity which is thereby induced affords the surgeon ample time to accomplish the no less important object of preventing the recurrence of the affection.

In some cases, where the inflammation has not attained so great a height, it is possible to dispense with the operation, by putting the sphincter into a state of temporary paralysis by means of the extract of belladonna diluted with the liquor plumbi diacetatis. This applied round the anus will effect such a relaxation of the sphincter as will admit of the finger, smeared with the same preparation, being introduced into the rectum; and the neuralgic condition of the parts which keeps up the inflammatory action being for a time annihilated, there are reasonable grounds for hoping that by the administration of mucilaginous glysters, the application of leeches, or the puncturing of the distended veins about the verge, and by the proper employment of a hip-bath, the severer operation may be prevented. And even should a disposition to relapse be manifested, a repetition of the application will prolong this artificial repose, and enable the surgeon to continue his efforts to dislodge the offending contents of the intestinal canal.

In the administration of glysters it is important to bear in mind the danger which attends an attempted introduction of the pipe of the instrument during a state of spasm. It is calculated to produce severe mischief in the interior of the gut by its sudden projection on overcoming the obstruction it encounters at the orifice; and it is to be feared that, by its traction on the skin of the aperture, it may split it and produce that complication of this affection which has been described by Boyer under the name of fissure of the anus, and to which we shall immediately advert.

On no account, then, should a glyster-pipe be pressed against the orifice of the anus until the spasm shall first be overcome by other means, and even then it should be introduced with great care and gentleness.

There is a great probability that persons who habituate themselves to this mode of relieving their bowels do injury to themselves, sometimes by their clumsiness and sometimes by their haste, in consequence of the pipe being formed of one unyielding piece. If the tube were composed of two parts, so that the portions destined to enter the rectum should be connected with that attached to the syringe or bag by the intervention of a cylinder of caoutchouc about an inch in length, the terminal extremity would, by reason of the flexibility of the connecting material, be enabled to turn aside when it met with opposition, to find, as it were, its own way; and to adapt itself to the direction of the cavity of the gut; thereby avoiding the possibility of wounding either the anus itself or the parts beyond it.

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[1] Op. cit p. 53.

In connexion with spasm of the anus we may notice the effects produced by a preternatural development of the sphincter muscle.

In treating of occlusion of the anus we have referred to the fact, that, at birth, there is sometimes so strong a contraction of this muscle in some infants, as to require the division of its fibres; but that, in others, it may exist in such a mitigated form as to render an operation unnecessary until that period of life has arrived when the fæces become solid.

There is, however, a still further modification of the same condition, which, although it is unattended by the pain which characterizes the former, nevertheless may give rise to morbid consequences. This modification appears to run in families, and depends on the original formation of the subject, the sphincter having in all such cases a preternatural development.

In the early periods of life, while the fæces are fluid or soft, there is but little embarrassment in the function of defecation; but, as they acquire solidity, a mechanical opposition is offered to their egress, and, by the act of absorption, they acquire a hard consistency, and it is only when they are abundant that, by the aid of powerful and long-continued efforts, the sphincter can be relaxed.

As the torpidity of the bowels, induced by such a detention of their contents, increases, the periods of dislodging the fæces become more and more distant from each other, so that a week or even ten days will elapse without visiting the closet; and then, perhaps, the attempt will be made, not from the promptings of nature, but in conformity with a settled plan of the patient's, who is conscious that the act ought to be performed.

It is in such cases that the incautious introduction of a glyster-pipe often does injury by cracking the skin or tearing a hæmorrhoid, exciting thereby so much activity, as to cause it to pass into the severest form of spasm or of spasm with fissure.

It is needless to exhaust our space by dwelling on the plan of treatment which we ought obviously to follow. To diminish the contractility of the sphincter, and to preserve a certain degree of softness of the dejections, are the points to be kept in view; the first of which will be accomplished by a steady, gradual, and periodical introduction of a bougie, smeared with an ointment containing a third of extract of belladonna, if the opposition be very great; and the second by occasional injections of warm water, by a proper selection of articles of diet, especially the substitution of bread made of undressed corn for that in ordinary use, by the exhibition of bark, if the atony of the bowels be great and long-continued, and by enjoining the patient to attempt the act of defecation at the same hour every day.

SPASM WITH FISSURE.

Patients labouring under spasm of the anus in its aggravated form, cannot conceive it possible, and will not believe it if they are told, that an addition could be made to their torments; and it is not until the spasm is complicated with fissure, that they are satisfied of the unwelcome truth.

Perhaps there is no affection in the whole province of surgery which is so much calculated to enlist the sympathy of the beholders in behalf of the sufferer as this, of which Boyer was the first to give a detailed account. It differs from simple spasm in the access of pain taking place when the fæces are discharged, and in there being a greater amount of pain on one side of the anus than in the rest of its contour; but as regards the general phenomena that attend it, it corresponds so entirely with that affection that they cannot well be considered separately.

The attention of surgeons has been directed to the question, whether the spasm be produced by the fissure, or the fissure by the spasm, and the alleged fact that there are numerous cases of spasm observed in which there is no fissure, but none of fissure unattended by spasm, has led the majority to the latter conclusion. The adjudication of this question is of no great practical importance when the disease is established, but if the opinion we entertain be correct, it might tend occasionally to prevent its occurrence.

It is admitted on all hands that spasm without fissure is not uncommon, and this very frequency creates a doubt, that of itself it can be the cause of fissure. That fissure is never observed unaccompanied by spasm is not quite correct, for in syphilitic affections of the anus, chaps or fissures oftentimes exist without exciting the sympathy of the sphincters or being attended with much pain.

There is nothing in the nature of the spasm which, *à priori*, would lead to the inference that it could produce fissure. The action of the muscles is towards, not from, the centre, and there is no tension by their means at any time exerted on the mucous membrane or skin; which, on the contrary, is still more folded, in a manner exactly the reverse of that which we should conceive would originate a fissure.

As, therefore, we can see nothing in the nature of spasm calculated to produce a breach in the mucous membrane, and as we find chaps existing without spasm, we incline to the opinion that they are not at all dependent directly on each other; but that the fissure is an accident occurring during the existence of spasm, and produced, either by the evolution of hardened fæces, or by the forcible introduction of the glyster-pipe.

This view is somewhat corroborated by contrasting the habits of those classes of society among whom the disease is prevalent, with those of people to whom it is nearly a stranger. The custom of washing out the bowels obtains much more extensively on the Continent of Europe than it does in this country, and more in this country than on the Continent of America. In a direct ratio with the prevalence of this custom do we find the disease in question, so that while it is but occasionally met with in England, (and, then not among the mass) it is of common occurrence in France and Italy, but entirely unknown to such of our American brethren as have not witnessed European practice.

It is to be borne in mind, that the habit of glystering is induced by a passive condition of the bowels, and is practised long before the patient comes under the observation of the surgeon, (indeed, most likely before the sphincters have become spasmed) and therefore he has no means of determining the priority of the phenomena; but we are strengthened in our opinion by the fact, that we have never seen or heard of a case of spasm of the anus in which a fissure occurred after it had been submitted to the care of a judicious surgeon.

The situation of the fissure is pointed out by the exquisite pain which prevails above the general suffering, but it is sometimes so superficial and indistinct that the eye cannot detect it. At other times by carefully putting aside the nates, pressing them downwards on each side, whereby all the furrows will be unfolded, and causing the patient to force down the gut, an ulcerated line will be seen, analogous in its appearance to the slit we observe in the winter-lip, and occupying the space between two of the folds which the skin forms as it enters the orifice of the anus. It is generally situated on one side or the other, and rarely to the back, and still more rarely to the fore part of the aperture. Its edges are of a dirty-yellow colour and sometimes slightly thickened; its depth is of a glaring red, and it sometimes extends a considerable distance up the rectum. The agony that is produced by the passage of the fæces over the ulcerated surface is so great as almost to bring on fainting or convulsions, and the mere discharge of wind is so painful and difficult to perform, that in the case of a lady treated by Boyer she had been reduced to the necessity of relieving herself by introducing a gum-elastic tube.

When the expulsion of the fæces is accomplished, there arises the same enduring pain as occurs in cases where fissure is not present; but it is either less in amount, or appears to be so, by the greater pain which precedes it. At all events, the acute, burning sensation which attends defecation, is succeeded by a sickening, bearing-down pain, which extends to the thighs, and which insensibly becomes more and more obtuse, but never entirely vanishes.

In the treatment of cases of this description, we cast aside all consideration of the fissure, and address ourselves to the cure of the affection to which the fissure is merely superadded. There can be no question that the division of the sphincter, on one or both sides, is the surest and readiest mode of placing the parts in a state of repose, and every consideration which would influence us in the treatment of spasm with congestion but without fissure, would be operative in those cases in which it is present. The alternate separation and approximation of its surfaces by the distension of the fæces, and the contraction of the sphincter, is prevented by this operation, and, in the majority of instances, it will be cicatrized long before the severed parts are reunited, if it be not comprehended in the incision. Boyer has described it as being the only mode in which relief can be afforded, and he attaches but little importance to dividing the muscle through the fissure. The object being to unload the congested tissues and to cut the string, as it were, of a tied-up bag, the fissure becomes a matter of subordinate consideration; but, nevertheless, as the same object will be gained by dividing the sphincter at the part where the ulceration exists, it may be, as Velpeau remarks, a point of prudence, if not of necessity, to let the knife act in that direction.

Some difference of opinion exists as to the certainty of success attending this operation. Boyer in the course of a long practice never found it to fail, while, on the other hand, Velpeau states that the same success has not attended it in the hands of others. He himself has witnessed two cases where death ensued after the operation; in one the pelvic viscera adhered to each other, and the cellular tissue was infiltrated with pus; and in the other, purulent deposits were found under the pelvic portion of the peritoneum. It does not, however, follow that the operation was instrumental in producing these effects, nor does it clearly appear that M. Velpeau is of opinion that the avoidance of the operation and the adoption of other means would have been attended with a more happy termination.

Dupuytren has recommended the employment of a plug smeared with an ointment composed of one part of extract of belladonna, one part of diacetate of lead, and six parts of lard, gradually augmenting the size of the plug until it is as large as the fore-finger.

Velpeau reports that M. Dubois was accustomed to maintain that plugs gradually increased in size would constantly succeed; and that, acting on this opinion, he has himself so completely succeeded in two instances as to induce him to recommend the practice.

There can be no doubt that lead and belladonna will be of great service in any case, not however as a cure for the fissure, but in relaxing the muscles; and the application ought always to be made, even if the operation be indispensable, as it is thereby rendered more easy of performance and less distressing to the patient.

We apprehend, however, that this system of plugging is admissible only when the engorged tissues have relieved themselves by the formation of false membranes, in the same manner as takes place in croup, or otherwise, by activity of treatment, been reduced from an acute to a chronic state. Then, indeed, it may be wise to pause before operating, for it is not unlikely that distant parts have been so impressed by the vivid action which has prevailed in the rectum, that positive inflammation might be excited in them by the action set up to reunite the severed structures. But precisely the same reasons which lead us to doubt the applicability of bougies where there is active inflammation *without* fissure, lead us to discountenance a proceeding, which is the same in principle, in similar cases *with* fissure.

It sometimes happens that when the operation has been performed, the pain and prominent symptoms are relieved for a time, and the incision heals kindly until nothing but the original fissure remains, and this obstinately refuses to cicatrize. A train of symptoms similar to, but of a more subdued character than, the former ones, appear, and a second and even third operation may be attended with a like result. In most instances of this kind the indisposition to heal may be attributed to defective general treatment, and more will be done to remove it by a judicious inquiry into the condition of the several portions of the digestive apparatus, and acting on the information so obtained, than by any local treatment; though it is desirable to endeavour to produce at the same time a more healthy surface by the employment of topical means. So long as irritation is absent the ioduret of lead will be found to be serviceable in that, as it is in all other unclean sores; but, when the soft fæces begin to produce pain, the nitrate of silver, or, still better, the potassæ hydras will destroy its irritability and favour the formation of a healthy surface.

CONGENITAL IMPERFECTION.

The congenital imperfections of the anus, which it is sometimes in the power of surgery to rectify, are occlusion and imperforation; and, the probability of being able to render such aid, should impress on all persons engaged in the practice of midwifery, the necessity, not only of examining the infant at its birth to ascertain that there is an aperture, but of repeating the examination on the next and following days, that no doubt may exist that the aperture performs its function.

Occlusion.—On examining the fundament of new-born child, the indication of the anus may, as respects situation and form, be satisfactory; but subsequent events may prove that it is occluded so completely, as to offer as much resistance to the expulsion of the meconium as though it was imperforate; a resistance which, if not overcome, will destroy the child by the accumulation of fæcal matter in the intestines.

The sufferings of the infant, manifested by its cries, hiccough and the swelling of its belly, and the non-expulsion of meconium, render it imperative that the anus be explored. It will then be discovered that the anus is contracted, not only at its verge, but to some distance above it, as though both the external and internal sphincters were in preternatural activity. This occlusion is sometimes so perfect that it is difficult to insinuate a large-sized probe; and in a case we recently witnessed, it was sometime before the small end of a blow-pipe could be introduced, which was no sooner accomplished than the meconium was blown with considerable violence into the face of the explorer; showing thereby, that this affection is dependent on the condition of the sphincters, and not on the mere narrowing of the tube.

This condition of the muscles might, in most cases, be overcome by the employment of bougies, increasing their size according to the success obtained; but the urgency of the case is too great to admit of the adoption of so tardy a mode of relief, especially when, by a simple operation, the obstacle may be speedily overcome.

A conductor being introduced, a bistoury should be carried in its groove to the distance of about an inch; and then drawing the handle outwards, so that the extremity of the blade may press in the groove of the conductor, it should be drawn obliquely downwards and outwards, towards the tuberosity of the ischium, in such a way, that the lower part of the incision may extend about a quarter of an inch from the anus. The same plan should be pursued on the opposite side, and the incised parts dressed with spread lint.

Great stress is laid by some authorities on keeping a plug in the anus, to prevent the reunion of the sides of the wound. This might be of some service if the incisions were so slight as only to serve for present exigencies; as then the remainder of the cure must be effected by dilatation. But when the operation has been properly performed, there is no occasion for a plug, inasmuch, as the cut having passed across the direction of the muscular fibres, they will retract and drag the faces of the incision away from each other, so that if the object were to reunite them it would be difficult to accomplish it.

There is a modification of this occlusion in which, by its not being so complete, the meconium and fluid fæces during infancy are permitted to pass; and it is not until such time as the dejections acquire a certain consistency that the imperfection is discovered. Even the entire period of childhood may be passed without very aggravated suffering; but when the age of adolescence arrives, the pain attending the dejection of the fæces is intolerable, and that in proportion to their solidity. As in the former instance, immediate relief is afforded by cutting across some of the fibres in the manner previously described.

Imperforation.—The congenital defects of the rectum which might be ranged under this head are various. The intestine may be entirely wanting, and its place supplied by fatty cellular tissue, the colon above it ending in a pouch: it may terminate in the bladder of the male, or the vagina of the female child: it may be perfect but blocked up by the integument; and, in all these cases, there is no external appearance of the anus.

The intestine may degenerate into a cord, and at the lower part, re-assume its cylindrical shape, thus forming a pouch towards the anus; it may be interrupted in its course by a thickening of its coats, its sides approximating as though it were tied with a tape; or it may be interrupted by a membranous or a rigid septum, the diameter of the canal at that part not being diminished; and, in these cases, the anus appears to be perfect.

The intestine and the anus may be perfect, but, by the extension of the skin from one side to the other, the aperture may be wanting.

Anus closed by the skin.—A careful accoucheur would discover this defect at the time of birth, and by a timely and trifling operation, save the child the suffering it must undergo by delay.

The anus appears, on a superficial examination, to be formed naturally; there are the corrugated line and the plicated radii passing from it; but on separating the nates a pale blue line is observed, its colour being produced by the meconium above it; and, pressing with the finger, a cavity is readily detected beyond it.

This skin or membrane sometimes is not attached to the anterior part of the margin of the anus, but advances forwards on the perineum, forming a short canal through which the meconium may be squeezed in drops.

Slitting this membrane with a sharp pointed instrument, and taking hold of the divided portions with a pair of forceps, that they may be cut away from their attachments with a pair of scissors, is all that is to be done in an operation which can never fail when it is timely performed.

Anus closed by integument.—In this defect the usual signs of the anus are wanting, and the surgeon will have to guard his reputation by not too confidently prognosticating the favourable issue of an operation. It may be a case in which there is no rectum, or, if one exist, in which it opens into the bladder or vagina, according as it may be a male or female child; though that fact would soon be set at rest by the transmission of meconium from the organ.

As so much uncertainty prevails, it is necessary to be guarded, both in our opinion and practice; for if it should turn out that there is no rectum, or that it terminates midway in a pouch, it will be only remediable by a proceeding, to be hereafter described.

But there are sometimes grounds sufficient to justify a favourable or an unfavourable prognosis. If the integuments on the part where the anus should be, be a plane even surface, and, more especially, if it should bulge downwards from the os coccygis—if one buttock should insensibly glide into the other by an undulating surface,—if there be no attempt at a corrugation of the skin, and if a sensation of solidity be communicated to the touch, it is highly probable that the rectum terminates at some distance within the pelvis: but if, on the other hand, there shall be a fair cleft between the buttocks; if the integuments be well drawn up so as to form a sulcated line (bearing in mind that in well-formed children it is less marked than in the adult); if there be any appearance of an attempt to establish folds of the skin; and, more than all the rest, if a digital examination (that *tactus eruditus* which may be conceived but cannot be expressed) should satisfy the surgeon of the existence of a cavity, the presumption is, that the rectum will be found at no great distance within the pelvis.

The operation consists in making a crucial incision through the integuments (the flaps of which should be turned aside) and in carefully pursuing the dissection in the direction of the rectum. The finger should be introduced into the wound after each application of the knife, with a view to ascertain the situation of the gut. This may be ascertained immediately after the operation has commenced, when the gut is near, for the rectum is sure to be distended with meconium, and, therefore, easy to be appreciated by the touch.

Whether the surgeon will pause when he has unsuccessfully attained the situation where the sphincters ought to be, or whether he will continue his dissection in the direction of the sacrum, as he may be encouraged to do from the success obtained by others, will be a question for his own judgment to determine; but this rule ought always to be abided by, never to plunge a trochar, or any other piercing instrument, at hazard, but always to use the knife, carefully exploring the way until the distended rectum can be felt.

Anus perfect, but the canal interrupted.—Here, again, it may be an affection of a very serious character, or one remediable by the means already described. An examination with the little finger will furnish reasons for presuming it to be one or the other.

When the obstruction is caused by a membranous septum, it will project by reason of the meconium accumulated above it pressing it downwards, but it will recede when the child cries. If the nail be rather long, it will readily rupture it by working against it in the intervals of the fits of crying; or a pair of short-bladed scissors may be introduced along the finger, their points passed through the membrane, their handles gently separated, and the membrane may thus be sufficiently torn for the immediate purposes of the child. It will be necessary to introduce daily a bougie, increasing the size until one of half an inch diameter will readily pass up the gut.

In those cases where the top of the pouch is pursed, and has a thickened feel, leading us to suppose that they depend on a thickening of the coats at that part, the only means of relief will be by introducing the canula of a trochar, and, holding it fixed against the point of opposition, to force the stiletto through it. There is more uncertainty in the result of this operation than there ought to be in any act connected with science; but it is an uncertainty, which, as we cannot free ourselves from without, perhaps, sacrificing a life that might be saved, we must not hesitate to risk.

As in the former species of obstructions, so in this, bougies must be introduced, and suffered to remain in the aperture; not, however, with the same view (which, in that instance, was to dilate the opening in the membrane) but to stimulate the vessels to absorb the effused lymph which always attends, though it may not entirely produce, this form of obstruction. The introduction of bougies must, therefore, be more protracted, and their size more cautiously increased, to carry out the end we propose to ourselves.

When the gut tapers to a point, and the finger can recognize nothing through its parietes, or when the whole of the space which the gut should naturally occupy is filled up with cellular tissue, it will prove to be one of those unhappy cases in which the rectum above is degenerated into a solid cord, or terminated in a *cul de sac*, and in which the experience of MM. Roux de Brignolles and Amussat may lead us to hope for better results than we have yet dared to look for.

It has been generally supposed hitherto that cases in which the lower part of the rectum is wanting for one and a half or two inches, as well as in those in which the intestine communicates with the bladder, vagina, or male urethra, by an opening insufficient for the discharge of the fæces, must of necessity terminate fatally. Such, indeed, has been the opinion of the most eminent surgeons, for the opening of the abdomen above the iliac fossa, or the blind plunge with the trochar in the perineum, afforded too slender a chance to be accounted for any thing. On this point of surgical practice, nevertheless, a very decided improvement has been achieved, and the pale of art has been enlarged, so as to admit for remedy those cases which, being deemed beyond its resources, were until lately abandoned to their unhappy fate. The imperforation of the anus in which there is nothing to indicate the vicinity of the rectum, is unquestionably one of the most embarrassing occurrences in surgery, whether we regard the fragility of the subjects, or the gravity of the operations necessary for their relief; but the evil is not desperate. We lay before the reader an abridged account of two cases of imperforation of the anus, treated successfully by operation, which show that we should not despair, even under the most unfavourable circumstances, of correcting these malformations by a decided, but cautious, method of proceeding.

The case of M. Roux de Brignolles, was one of imperforation both of the anus and urethra. The labour having been superintended by an ignorant midwife, the infant had been left nearly two days without succour. M. Deveze, a neighbouring practitioner, having been called in, he soon ascertained the existence of the imperforations. The urethra was closed by a thin membrane at the base of the glans, constituting a sort of hypospadias. The penis being swollen and erect, this membrane was perforated with a stilette at once, and the urine was voided.

Two days had elapsed before the consultation was held; the countenance of the infant exhibited signs of deep suffering, the skin was yellow and dry, the abdomen tympanitic and painful, and the convolutions of the intestines could be distinctly traced upon its surface; there was frequent hiccough, with vomiting of the milk and sugared water that had been given. When the infant cried, there was neither movement nor prominence in the region of the anus, from which the proximity of the rectum might have been inferred; nor could any indication be obtained by exploring with the finger. Here was obviously one of those unhappy cases, of which so unfavourable a prognosis has been given by Petit, Boyer, and many of the most eminent surgeons, viz. that *in which there is no trace of opening, the anus being closed up by the skin, which is hard and thickened*, and for which an operation in the region of the anus is, at first, no better than an exploration. M. Roux, however, was resolved to hazard an attempt to save the child's life, and performed the operation for opening the rectum in the following manner:—

The little patient having been placed on the lap of an assistant, in the same manner as for the operation of lithotomy, an incision was made in the skin, about an inch in length, in the exact line of the raphé, which could not be seen in the perineum. On separating the lips of the wound, the fibres of the elliptic muscles of the sphincter could be seen; their internal borders were in contact, and presented a straight line, but they contracted in a circle and with considerable force, when the infant cried. The incision was continued through the levatores ani muscles, to the depth of an inch, the edge of the knife being directed backwards towards the coccyx. The incision at this depth terminated in a mass of cellular tissue. So far, the dissection was made with a scalpel; a straight bistoury was now directed into the interior of the pelvis, the point being turned obliquely upwards and backwards, in order to avoid the bladder. It soon entered a cavity, which was supposed to be the rectum; the handle was then raised, and the blade withdrawn in this position for the purpose of enlarging the internal incision. The meconium, which now came slowly forth, announced the success of the operation.

Abundant injections of marsh-mallows water were now thrown up, to wash out the intestines as quickly as possible. The first phalanx of the index finger reached to the bottom of the wound, which was dressed with a thick mesh of charpie smeared with ointment.

This mode of dressing was kept up for fifteen days; after this period, granulations began to sprout from the edges of the wound, impeding the progress of the fecal matter, producing colic pains, and giving rise to another remarkable phænomenon.

As soon as the anal opening began to be obstructed, the stools became less frequent, and more difficult, and the urine which was voided, pure and limpid, was followed by a small quantity of excrementitial matter. The wound having been enlarged towards the coccyx, the bowels were again easily relieved, and for some days the urine alone was voided by the urethra. But again the granulations springing up, and obstructing the anus, the fæcal matter was observed to be passed, though in small quantity, after the urine. These were checked by the application of nitrate of silver, and the artificial anus having been kept open by the introduction of large-sized bougies, till its cicatrization with sufficient dimensions was completed, fæcal matter was no longer observed to come by the urethra. The border of the anus itself, after a little time assumed the plicated appearance of the natural outlet.

M. Roux blames the mode adopted by other surgeons in treating those cases, by puncture with a bistoury, lancet, or trochar, as hazardous; whilst, on the other hand, by a slow and methodical dissection of the muscles of the perineum and anus in the median line, the surgeon readily ascertains his chances of success, for as soon as he has passed the elliptical muscles of the sphincter, and the levatores ani, he enters upon the cellular tissue, in which the finger will enable him to detect the intestine. There can be no doubt that the finger is by far a better exploring instrument than a probe or sound. It is possible, however, (although the case must be extremely rare,) that the rectum may be entirely wanting, and, in such a case, the only chance of saving life would be, to cut into the sigmoid flexure of the colon, as successfully performed by Duret of Brest, thus establishing an artificial anus above the iliac region.

M. Roux' theory as to the formation of the rectum, is the same as that of M. M. Serres and Geoffroy St. Hilaire, who account for the atrophy or absence of the organs generally, by the deviation or absence of their nutrient arteries. The arteries of the rectum are derived from the inferior mesenteric, the hypogastric and the pudic; collectively they are called *hæmorrhoidal*, being distinguished into the superior, middle, and inferior; but their origin being different, they are very rarely all absent in the same individual, and hence a well-grounded hope may be entertained, when the inferior extremity of the gut is wanting, that it will be found higher up, in front of the sacrum. In M. Roux' case, the imperforation, as in most of those cases, was attributable to the deviation, or diminution in calibre of the branch of the pudic, which is, in reality, the *formative* artery of the inferior extremity of the rectum; and hence it happens that imperforations of the anus are often accompanied by malformation of the sexual organs. The passage of fæcal matter, which, it will be remembered, was voided by the urethra, when the artificial anus was obstructed by granulations, is explained by M. Roux, by supposing that a sort of urachus, provided to remedy the obliteration of the natural outlet, and formed by the deviation of the inferior hæmorrhoidal artery, a branch of the pudic which supplies the penis, was prolonged anteriorly from the blind extremity of the rectum into the urethra. From this deviation or absence of the arterial branches, where the rectum is wanting, he also accounts for the little blood shed in the operation, not amounting to a tea-spoonful.

M. Roux thinks that the elliptic muscles of the sphincter and levatores ani, which receive their nutrient arteries from the ischiatic, are never wanting; and hence, that their utility in the act of defecation, should not only be calculated upon, but secured, by conducting the dissection in such a manner as to free their internal border: the artificial anus being thus established in the line, by which they are naturally separated, their liberty of action is preserved.

Fig. 106.

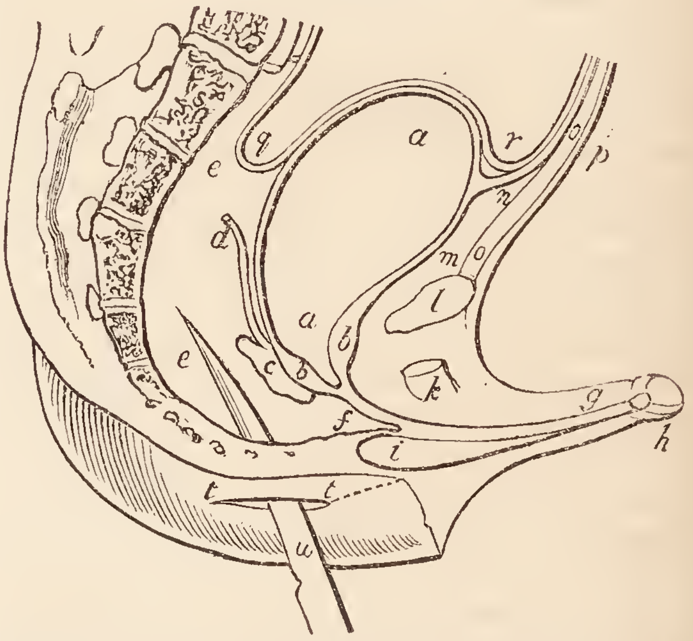

Fig. 106 *represents an imaginary section of the pelvis to explain the imperforations of the anus and urethra as they were supposed to exist in M. Roux de Brignolle's case: a a, the interior of the bladder; b b, section of the prostate; c, the vesicula seminales; d, the vas deferens; e e, the interior of the rectum; f, supposed termination of the rectum in front of the neck of the bladder; g, the penis; h, the opening of the meatus; i, bulb of the urethra; k, root of the right corpus cavernosum; l, section of the pubis; m, space between the pubis and bladder; n, the urachus; o, the muscles of the abdomen; p, the skin; q, r, the peritoneum lining the cavity of the abdomen; s s, sacrum; t t, the incision in the perineum; u, the bistoury, its point in the rectum.*

This operation, performed 15th May, 1833, was soon followed by another, with an equally successful result. M. Amussat, whose case it was, thus describes it in a communication to the Academy of Sciences.

Mrs. B., an English lady residing in Paris, gave birth, on the 6th September, 1835, to a female child. The external parts being well-formed, the real nature of the case was not suspected at first. M. Deneux, who attended the lady, in a note to M. Amussat, requesting his assistance, describes the case as "*one of occlusion of the large intestines in a new-born infant; the anus being well formed: the rectum communicates with the vagina, and the obstacle appears to be situated high up.*"

M. Amussat did not see the infant till thirty-four hours after its birth. No meconium had been voided, and the nurse stated that the tepid water injected into the anus, returned by the vulva. The child seemed strong, and well proportioned. The abdomen was hard, and swollen. The anus and vulva were, to all appearance, natural. A flexible canula introduced into the anus penetrated to the depth of two inches, and the water injected through it, came out immediately by the vulva. A sound, introduced by the vulva into the vagina, struck the canula previously introduced into the anus.

"We were of opinion," says M. Amussat, "that the rectum was obturated at the depth of about two inches, and that it communicated with the vagina; that there existed a species of recto-vaginal fistula, or, in other words, that the septum by which the rectum and vagina are parted, was deficient to a considerable extent.

"On communicating to the parents that an issue could only be obtained, either by the anus, or by the abdomen, and exposing the dangers and inconveniences attaching to both these operations respectively, they preferred, decidedly, that the attempt should be made to make an opening by the natural route, rather than through the abdomen, although we declared to them at the time, that this plan, even if successful, would of necessity leave a communication between the rectum and vagina. It was accordingly decided, that an attempt should be made to discover the interrupted intestine.

"With this view, I proposed dilating the anus with prepared sponge. At four o'clock in the morning, a bit of sponge an inch and a half long, but somewhat smaller than the little finger, was introduced into the anus, and supported by a T bandage. This piece was to be removed at eight o'clock, and another somewhat larger introduced, to remain till twelve, at which hour it was agreed that an operation should be performed, if necessary.

"At eight o'clock, the sponge was withdrawn, it having dilated the anus to such an extent, that I was enabled to introduce the little finger, making it come out again at the vulva; but higher up it was stopped, as if it had been in a *cul de sac.* During this exploration, the urine was voided in considerable quantity. Another sponge tent, longer and thicker than the first, was now introduced."

At twelve o'clock, when the consultants, M. M. Deneux, Lebaudy, and Amussat met again, the anus was so much dilated as to permit the introduction of the little finger with ease; the *cul de sac* and the communication were again recognized. An examination was now made, in order to discover the rectum distended by meconium, and to perforate it.

"We were still persuaded that, in doing this, a recto-vaginal fistula was unavoidable. However, in again exploring with the index finger, I discovered at the upper and front part of the cavity, a sort of fungous narrowing, which I at first mistook for the narrowed or obturated point of the intestine. Above and behind, the soft bag, which I imagined to be formed by the rectum, could also be felt. In describing what I felt, I stated that it communicated the same sensation as if I was touching the effaced and soft neck of a uterus. Each of us having examined in turn, M. Deneux thought that it was in reality the neck of the uterus, and such it proved to be."

The case, as now established, turned out to be this: the anus, without rectum, opened into the vagina, in which the vulva and anus communicated with each other: and thus there were, strange to say, two openings in the perineum, instead of one, both terminating in the vagina.

"On thus discovering, that I had to deal with an extraordinary malformation, consisting in the absence of the rectum or a part of the rectum, I determined to explore carefully, the entire pelvis, through the walls of the vagina. In feeling with the end of the finger, to the left of the sacro-vertebral angle, through the posterior wall of the vagina, I detected a flattened body, which yielded under the finger. On repeating the examination several times, the sensation was always the same. Reflecting on this circumstance, I became satisfied that what I touched must be the rectum; my colleagues were of the same opinion. The obscurity which hung over the case was now completely dispelled; it was evident that the vagina alone occupied the cavity of the pelvis, and that the extremity of the imperforate rectum was situated above, behind, and to the left of the sacro-vertebral angle. I now felt, in a manner, relieved from the difficulty which the operative proceeding must present, in so delicate a case, and resolved at once to reduce to practice, the operation which I had long thought of for similar cases.

"Before commencing the operation, we again satisfied ourselves, that the membranous body which we felt, was the termination of the rectum, placed at the height of about two inches from the skin of the perineum.

"The plan I intended to adopt had been suggested to me by my failure in two other cases, on which I had operated, in conjunction with my friend, Dr. Roussel, and in which the imperforate rectum terminated at the distance of one and a half to two inches from the skin of the perineum. In both of these cases, I had made the incision at the place where the anus ought to have been; dilated the wound with prepared sponge, and, in fine, perforated the rectum distended with meconium. The infants became yellow, and died in a few days. I attributed the unsuccessful results to the resorption of bile and meconium, as they passed along the bleeding cellular surface of the artificial opening. Being averse to Littre's operation, I was still of opinion that it would be better to restore the natural passage, if the danger arising from the resorption of these fluids could at the same time be guarded against, and this I thought might be effected by drawing the intestine down to the external opening, and then fixing it by points of suture. Experiments on the formation of artificial anus in animals, had convinced me, that, by this means alone, the evils of resorption, infiltration, or stercoral abscess were to be with certainty avoided.

" A proposition so extraordinary was not adopted at once. My fellow-consultants made many objections, chiefly on the score of hæmorrhage, abscesses, &c., which were fairly discussed; and it was not until I had fully developed every step of the plan I meant to execute, that I could obtain their consent. These steps were as follows: to make an opening in front of the coccyx, behind the vaginal anus, to detach with the finger, and with the bistouri the posterior paries of the vagina, from the coccyx and sacrum; to ascend thus to the *cul de sac* formed by the rectum, and, after recognizing it both by the vagina and by the new passage, to lay hold of it with a pair of erines; to detach it all round more with the finger, than with the bistoury; to draw it down to the opening in the integument, open it largely, and, after allowing the meconium to flow, to connect, in a secure manner, the opening of the intestine with that of the skin."

" The state of the case being once more submitted to the parents, and having now announced to them, that if the operation proved successful, there would be no recto-vaginal fistula, we found them resigned to the bold operation we were about to perform.

" The infant in the mean time had been placed in an emollient bath, in order to calm the irritation produced by our explorations, and by this means, was still better disposed for the proceeding.

" Every thing being now ready, the infant was placed on a table, in the same position as for lithotomy. A transverse incision of about eight lines in extent, was made just behind the vaginal anus, with a short-bladed bistoury, convex on its edge; another incision directed towards the coccyx, gave the form of a T to the opening by which my finger was introduced, to make a passage between the vagina on the one hand, and coccyx and sacrum on the other, having previously placed a sound in the vaginal anus, to serve as a guide, to protect its posterior wall from injury. I partly cut and partly tore the cellular tissue uniting these parts. Proceeding in this way, I penetrated till I discovered the end of the rectum. at the depth of two inches. From the instinctive efforts of the child, we were all much better able now to recognize, through the vagina, the sort of pouch formed by the rectum. I now seized it with a double erine, and drawing downwards, I disengaged the intestine from the slight adhesions by which it was on all sides surrounded, except on that of the vagina, where I was obliged to make a cautious use of the bistoury. The extremity of the rectum soon became visible within the wound, and, to our great satisfaction, we saw the meconium oozing out at the punctures made by the crooks of the erine. Having passed a needle and thread through the end of the intestine, it was brought down to the level of the integuments. A large opening was now made, from which issued a quantity of meconium and flatus. The operation was terminated in the following manner:—traction having been kept up by means of forceps, until the lips of the wound in the intestine were drawn beyond the opening in the skin, I attached them by three points of suture at each of the angles of the wound; but these being found insufficient to prevent the intestine from ascending, six or eight points more were made all round its circumference.

Fig. 107.

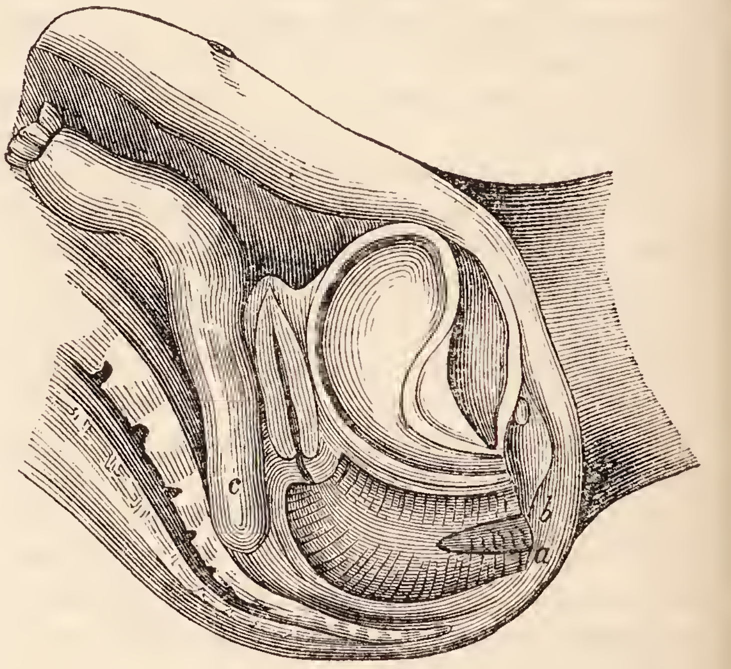

Fig. 107. *In order to render the details of this operation intelligible, M. Amussat has given a plan of the parts as he supposed them to exist before the operation. He took pains to make the analogy as complete as possible, by taking his sketch from a left-side view of the interior of the pelvis in a female child who died a few days after birth. All the organs in the pelvis had been cut in two, part of the rectum was removed, to represent the deficient portion of the intestine, and the anus was made to communicate with the vagina. a and b represent the anus and vulva, which were properly formed, and communicated with the vagina only. c, the extremity of the rectum forming a* cul de sac *below the sacro-vertebral angle, and having no communication with either the anus or vagina.*

" There was but little blood lost; injections were thrown up to empty the bowels; the child was placed in a hip-bath, and poultices were applied. She soon recovered her strength and warmth, on being placed beside the mother. No fever followed the operation.

"After a lapse of twelve days, the anus showing a disposition to become narrow, it was necessary to have recourse to the introduction of meshes smeared with tallow, for which gum elastic bougies were substituted after a few days."

These two cases are of the highest interest, and present a point of comparison, upon which it may be useful to dwell for a moment. In M. Roux' case, the patient was a male, and the rectum was opened at the point where it was found within the pelvis. The inconvenience and suffering resulting from the growth of granulations along the track of the wound, was severely felt, and might have compromised the ultimate success of the operation. M. Amussat having observed, in two cases in which he had previously failed, that his want of success was attributable to the resorption of bile, infiltration, and the formation of abscesses along the artificial opening, supposes, and apparently upon strong grounds, that the fatal termination which almost always takes place in a short time, when the rectum has been opened with a trochar, bistoury, or lancet, may be accounted for by the want of protection which a mucous surface would afford to the new passage. He relies for his conclusion, it is true, only on one case, but, as he very justly remarks, "This case is not to be regarded merely as an additional testimony in favour of the power of surgery; the success of the operation is a point of inferior interest, when compared with the possibility of doing in almost every case, that which, before this operation had been performed, we had no idea might be done; in a word, the important point, was to show that we could accomplish through the natural passage, that which Littre had proposed to do through the parietes of the abdomen, and which A. Dubois, Descaux, Duret, and others had executed."

M. Amussat reduces the various malformations of the anus to five species, which he classifies thus:—

In the first the anus is preternaturally narrowed; in the second, the anus is closed up by membrane; in the third, the rectum is intercepted by a simple septum, at a variable distance from the anal opening; in the fourth, the anus is imperforate, and the rectum is deficient to a greater or less extent. This is the most numerous class of these malformations, and comprises the case above described, as the vaginal anus may be regarded merely as a superfluous opening. In the fifth, the rectum opens into some other organ, as the bladder, urethra, and vagina, or at some point of the pelvis or sacrum. Each of these species, he advises should be treated as follows: in the first, an incision of the anus should be made, and the opening dilated; in the second an opening should be made in the centre of the membrane, which should be excised all round as high as the sphincter, and the opening maintained by means of tents or meshes; in the third, after dilating, or slitting the anus at its back part, and on its side, the mucous membrane should be detached and the rectum drawn down, the inferior portion is then cut off, above the septum, and the gut is sutured either to the sphincter, or what is still better, to the skin. M. Amussat thinks himself justified in proposing this operation, on the ground that in the cases where the septum has been only punctured, the children have died; in the fourth, M. Amussat's example is the best that can be followed. It may, however, be observed that although he deserves the highest praise for the great skill and judgment displayed in the planning and performance of this interesting operation, the surgeon, in any similar undertaking should not overlook the very great importance of utilizing the sphincters wherever it is practicable. The external incisions should therefore be so conducted, that the rectum when drawn down, shall be in its natural situation between them, for thus only can the complete function of the anus be established. In the fifth, he is also of opinion that the same process may be adopted, unless the abnormal anus performs its functions satisfactorily. But when the intestine opens into the bladder or the urethra, the posterior wall only should be drawn down, because if the opening could not be closed an extravasation of urine might ensue.

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(*John Malyn.*)

ANUS, ARTIFICIAL. This term is often confounded with Anus, Preternatural. Strictly speaking, the artificial anus can only be formed by the express intervention of the surgeon; as in the cases described in the preceding article, or when, in the operation for relieving an incarcerated portion of intestine, he discovers that the bowel has sustained too much injury to be safely returned. Under the latter circumstances, he may prefer making an opening into the intestine itself, and in this sense also the anus is said to be artificial. But it may be also formed accidentally, as in wounds of the abdomen, or when the intestine has given way spontaneously, and adhesions are formed to the abdominal walls, all round the opening. As both these terms are inaccurate, we shall refer the reader to the article Fistula, Intestinal.

AORTA, (See Arteries, Diseases of).

APHERESIS, or APHÆRESIS,. (ἀπὸ, 'from,' and αἵρεσις, 'taking away.') Hippocrates employed this word to designate the removal of a part of the body; in a more precise sense, it has been applied to the removal of parts by operation, or to that department of surgery which treats of such operations. It also represents the opposite or counter-sense of the term 'Prothesis.'

APONEUROSIS, from ἀπὸ, 'from,' and νεῦρον, 'nerve;' the ancients imagining these webs to be expansions of the nerves. *Aponevrose*, Fr. Flesche, Ger. This name is given to a class of inextensible membranes, of a bright silvery hue, and fibrous texture. Aponeuroses present various degrees of density, being in many places as fine as the cellular tissue itself; whilst in others it seems to pass into tendinous expansions, or strong fibrous bands, which may be considered as extensions of the osseous skeleton. They form an envelope for the entire body, and are therefore co-extensive with the external integument, with which they are connected by numberless prolongations: they also envelope the muscles, sending prolongations between their fibres, and even sometimes forming complete interruptions in the course of their length. Although the term has received so extensive a signification in common language, a difference is recognized; the general attenuated webs lying beneath the skin, as well as in other situations, being called *fasciæ*, while the denser flat webs which envelope some of the powerful muscles, and furnish them with attachments to bones, are distinctively called *aponeuroses*. They present a vast number of septa, forming, as it were, chambers for the muscles; thus isolating them completely from each other, and maintaining them in their proper situations, while they also support them in their contractions, or moderate their violence. In some situations they are provided with tensors, as in the upper and outer part of the thigh; in others, they are cushioned on fat, to moderate their tension, as in the palmar and plantar fasciæ. Much, therefore, of the power of the muscles, and of their uniformity in action, depends on these fibrous envelopes; the great vessels and nerves are also indebted to them for protection, while the venous and lymphatic circulation is assisted by the constriction, which they exercise under certain circumstances.

Strong and unyielding, in inflammations of the cellular tissue beneath them, their resistance is the cause of the excessive tension, and long confinement of the pus, so common in parts where they are strong and numerous, The surgeon should therefore be well acquainted with the situations of the various aponeuroses, in order to be able to act with judgment, promptitude, and effect, in liberating matter when once formed, which otherwise would remain pent up, disorganizing the fibrous sheaths which opposed its progress towards the surface, or burrowing through and separating important parts in search of an outlet, and affecting, seriously and permanently, the usefulness of muscles, tendons, &c. When no issue is afforded, the vitality of these expansions being low, they soften and die, becoming riddled with holes, or sloughing more or less extensively. The same observations will of course apply to extravasations of whatever kind they may be. When these fluids are left to find distant openings by circuitous routes, scattered abscesses and fistulous tracks are formed, which will require numerous counter openings.

When suddenly and forcibly stretched, they are liable to be torn, like the tendons, but if the extension be induced slowly, they grow thin and fray, allowing herniæ of their contents; when once in this state, their want of elasticity prevents their perfect recovery. Eventrations of this description occur from Ascites and Pregnancy. The author of this article saw the displacement of the biceps humeri arise from this cause.

APOSTASIS, (ἀπὸ, and ἵστημι, 'I stop.')

A collection of pus formed at a distance from its source; an abscess by congestion.

APPARATUS, *appareil*, Fr. The general term apparatus designates the assemblage of all those implements and objects required by the surgeon in the execution of operations, as well as in the application of bandages and dressings.

Besides the instruments suited to particular operations, which are generally arranged beforehand, and disposed in cases, very many articles, the necessity for which is common to all operations, must be prepared on the spur of the moment; and a skilful surgeon will not confine himself to what is absolutely necessary, but will endeavour to foresee every possible emergency, so as never to be at a loss or delayed, during the progress of an operation. We shall, therefore, in the first place, take a survey of those general preparations on which the success in some cases, and, in all, the prompt and dexterous performance of surgical operations so much depend.

Although such matters are generally left to the assistants, the operator must not neglect to satisfy himself that warm and cold water, sponges, and towels, are in readiness; that bandages, compresses, adhesive plaster, lint, and other dressings, are previously prepared and arranged; that tourniquets, scalpels of various forms and sizes, tenacula, and the usual contents of the pocket-case are at hand; and, finally, a small tea-pot, containing wine or other restoratives, should never be forgotten.

The apparatus furnished by the surgical instrument-maker, is arranged in sets according to the particular operation; thus we have cases of instruments expressly for trepanation, amputation, lithotomy, hernia, paracentesis, cataract, &c., the contents of which will be specified in the articles on those subjects. The pocket-case for general purposes ought to be provided with instruments for the most common and simple operations, as well as those necessary for conducting dressings; these consist of a double-edged scalpel, straight and curved bistouris, (those made to close with a clasp are the most convenient) scissors, a spatula, dressing and ligature forceps, tenacula, directors, probes, a caustic case, needles and ligature-silk; a female catheter, convertible into one suited to the male urethra, by screwing to its open extremity a straight canula adapted to the purpose, is a frequent and useful addition.

It is the duty, further, of the surgeon to ascertain that each instrument is in its proper condition, and, when disposed in the order required by the stages of the operation, to take care that a cloth be thrown over the whole, to conceal them from the eyes of the patient, a precaution which, notwithstanding the reproach of our continental brethren, is not always sufficiently attended to.

(*Henry T. Chapman.*)

APPARATUS, MINOR, MAJOR, and ALTUS, are names bestowed upon three modes of operating for the removal of stone in the bladder. (See LITHOTOMY.)

AQUEOUS HUMOUR. The aqueous humour is the small quantity of clear transparent fluid situated within the chambers of the eye[1]. It is secreted by a delicate membrane which lines the cornea,—is thence reflected upon the corneal and neural surfaces of the iris, and finally passes over, and is most intimately associated with the anterior capsule of the lens. This beautifully delicate membrane is divided by anatomists into three portions, named from the parts upon which they pass,—*corneal*, *iridal*, and *capsular*.

The aqueous humour is somewhat turbid, and of a reddish colour for about a month after birth, in consequence of the rupture of the pupillary membrane, which very generally takes place when extra-uterine existence commences[2]. In a healthy state of the eye, the clearness and transparency of the aqueous fluid continue until a very advanced age, when it has usually a cloudy, whitish appearance. When the aqueous fluid is discharged, it is very rapidly regenerated. It possesses powerfully solvent properties, so that when minute fragments of metal and other hard substances are forced into the anterior chamber, they are gradually dissolved by it; not, however, always; for on several occasions I have observed that such substances have acquired a delicate cyst, and have remained for years without exciting much irritation. There are forms of disease in which the aqueous fluid is much increased (CONICAL CORNEA, HYDROPHTHALMIA), and there are also morbid conditions, in which it is generally found to be diminished (ATROPHIA BULBI, SYNECHIA ANTERIOR).

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[1] The variations in the quantity, colour, &c. of the aqueous humour, at different periods of life, are minutely explained by Burrhy (De Artificio Oculorum Humores restituendi. 1669). Fabricius ab Aquapendente (Opera omnia Anatomica et Physiologica. 1687). Nuck (Tractatus de Ductibus Oculorum Aquosis. 1695). Hovius (Tractatus de Circulari Motu in Oculis. 1716). Petit (Mémoires de l'Académie Royale des Sciences de Paris. 1728). Zinn (Descriptio Anatomica Oculi Humani Iconibus Illustrata. 1755). Haller (Elementa Physiologiæ Humani Corporis. 1763). Porterfield (A Treatise on the Eye, the Manner and Phenomena of Vision. 1769). Wardrop (The Morbid Anatomy of the Human Eye. 1808). Clemens (Dissertatio sistens Tunicæ Corneæ et Humoris Aquei Monographiam Physiologico-pathologicam. 1816). Dalrymple (The Anatomy of the Human Eye. 1834).

[2] I am not aware that this has been previously mentioned as the cause of the red appearance the aqueous fluid assumes at the period of, and for a short time after, birth; but I have not ventured the opinion without adopting every means which occurred to me of ascertaining its accuracy. I am not now referring to that mere reddish appearance of the pupil, observed for several weeks after birth, and which is occasioned by the light brown colour of the choroid pigment, but to an actual redness of the aqueous fluid itself, which, however, is not noticed in those cases in which the pupillary membrane disappears by the cessation of its circulation, and the absorption of its wasted texture and vessels.

The characters of the aqueous humour become changed during the progress of various diseases, and many anomalous examples are recorded, in which the chambers of the eye have suddenly assumed a milky or a florid appearance, which has continued for a short period, and then disappeared with marvellous rapidity. In these cases, the individuals have generally suffered from periodical amaurosis, or some form of intermittent blindness[1].

A sudden effusion of blood into the chambers of the eye may result from local injury, from excessive exertion, coughing, vomiting, straining, a severe fall or blow, great plethora, or any undue excitement, and is indicated, when existing as the only appreciable defect of the eye, by pain, tension of the globe, impaired or lost vision, and, probably, also by great uneasiness in the head. In all such cases, the means of cure involve the adoption of the necessary measures for the prevention of local inflammation, or for its suppression, if it be present; with a due attention to the removal of general vascular fulness, if it exist. If the effusion of blood be considerable, the whole of the anterior chamber will have a dark red appearance, and the iris will not be visible; but it more commonly happens that a small quantity only is effused, which sinks to the bottom of the anterior chamber,—its upper margin being of a pale, and its lower border of a deep red colour, and of considerable consistence. This is not suddenly, but gradually absorbed. Walther and others refer to examples of this nature, in which the effused blood was small in quantity and disappeared almost instantaneously, so that I am induced to suppose it ceased to be visible by passing behind the iris, and was absorbed in that situation. Effusion of blood into the chambers of the eye has been said to occur periodically in a few instances, and to be vicarious of menstruation. No case precisely of this description has fallen under my observation; but I have met with two instances in which the aqueous humour has gradually assumed a faint pink appearance, without any distinguishable inflammation of the eye. In both these cases (which occurred in young women suffering from a temporary suspension of the catamenial discharge,) the part became clear and healthy under the use of simple local applications, and the disease has not recurred. Fungoid growths and abscesses of the iris sometimes occasion a sudden effusion of blood into the anterior chamber, but, in all such instances, the source of the hæmorrhage is sufficiently manifest. When a sudden and considerable effusion of blood takes place into the chambers of the eye, in a plethoric person, independently of any clearly ascertained cause, as respects the organ of vision, it is advisable to recommend the patient to be freely bled, and to go through a course of proper depleting treatment. When the effused blood exists in considerable quantity,—when a dense clot has sunk to the bottom of the anterior chamber, when the absorbent process proceeds very slowly, the cornea becoming prominent and discoloured, and the patient suffering severe pain,—it may be necessary to puncture the cornea, which, although it will not perhaps admit the transit of the clot, will, by permitting the escape of the more fluid aqueous humour, relieve pain, and lessen the risk of that extensive degree of staphyloma which will almost certainly follow the pressure of the irritating body against the diseased and probably semi-gangrenous cornea. By adopting this practice, I have, on several occasions, succeeded in restoring a certain degree of vision, and have also prevented the occurrence of any disfiguring alteration in the form of the eye-ball.

A turbid state of the aqueous humour is commonly noticed in very advanced life, and, in a still greater degree, in connexion with inflammation of its secreting membrane, or of the iris, or anterior hemisphere of the crystalline capsule. In old age, the aqueous humour sometimes becomes whitish, and a milky fluid has been said to be effused into the chambers of the eye when the mammary secretion has been suddenly suppressed (*Rosas*[1], *Clemens*[2]).

The rapid healing of ulcers of the legs has been succeeded, according to the opinion of Clemens[3], by an effusion of puriform matter into the chambers of the eye, which, however, have assumed their customary clearness on making an artificial ulcer in the site of the original disease. This has occurred under my own observation only in connexion with some form of inflammation of the eye, arising from the rapid healing of a sore, with the influence of which the constitution had been long familiar. Two cases are recorded, in which an hydatid formed in the chambers of the eye[4]. I have related an instance in which a small and somewhat globular body was found in the chambers of the eye, which appeared to me to be a dislocated lens preserving its transparency[5]; but several surgeons who saw the case, considered that I was mistaken, and that, in fact, it pretty closely resembled that condition of hydatid disease described by Soemmering, Logan, and Mackenzie. It has been long known that a species of thread-worm has been found in the chambers of the eye in horses and various other animals[1], but I am not aware that it has been noticed in the same situation in the human subject. Woolhouse, Richter, and subsequently Beer, have stated that globules of quicksilver have been found in the anterior chamber of the eye in persons who have been using mercury pretty freely, for the cure of syphilis; and the two former authors mention that they have noticed bubbles of air in the same part of the eye independently of any external wound.

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[1] I am now attending a young lady suffering from periodical amaurosis (dependent on derangement of the uterine system), in the anterior chamber of whose left eye a considerable number of minute whitish particles are occasionally to be seen. They are visible only when the dimness of vision is very great, and are not associated with any uneasiness or manifest signs of inflammation.

[1] Handbuch, vol. ii. p. 671.

[2] Scriptores Ophthalmologici Minores, vol. i. p. 142.

[3] Opus citatum.

[4] An account of the first case, originally related by Soemmering, may be found in Lawrence's Treatise, p. 669, and in Schmalz's *Tabulæ Anatomiam Entozoorum Illustrantes*. For a description of the second, the reader may consult the twelfth volume of the London Medical Gazette, and also a pamphlet published by Mr. Logan, under the title of "Animalcules in the Eye."

[5] A Treatise on the Diseases of the Eye, &c., vol. ii. p. 49.

In the case of hydatids or worms existing within the chambers of the eye, it has been suggested to destroy the life of the parasitical beings, by passing an electrical current through the organ of vision; by the infriction of turpentine around the orbit; and by the administration of irritating and bitter medicines. It appears to me that the following rules ought to regulate our practice:—So long as the eye is free from material inflammation, no surgical means, at least, are necessary; but as soon as even a slight degree of irritation supervenes, an attempt should be made to remove it, by the application of cooling lotions, the administration of purgatives, and the adoption of counter-irritation in some convenient locality. If these means are insufficient—if the irritation rather increase than diminish—then it would be proper to evacuate the aqueous humour, by a very small incision of the cornea, made nearly at its margin. This simple proceeding may cause the death of the offending agent; but if it should not do so—if, on the secretion of a fresh quantity of aqueous humour, the worm or the hydatid should be found to be alive, and capable of creating great irritation, then it would be quite necessary to make an opening in the cornea, sufficiently ample to admit of its extraction.

AQUO-MEMBRANITIS. Kerato-iritis—*Rosas*. Inflammation of the capsule of the aqueous humour—*Wardrop*. Inflammation of the anterior chamber—*Lawrence*. Aquo-capsulitis—*Mackenzie*. Inflammation of the membrane of the aqueous humour was first clearly pointed out by Wardrop (Morbid Anatomy of the Human Eye) in the year 1808, seven years after the inflammation of the texture it envelopes (the iris) had been described with such admirable precision and distinctness by Professor Schmidt.

General observations.—The disease may be acute or chronic, and it may affect the whole or merely a part of the membrane. I have seldom observed the disease after adult age; under my own observation it has chiefly occurred in children of a strumous habit, with light hair, blue eyes, a thin skin, and a very delicate organization. Mr. Wardrop appears to have witnessed the disease very frequently, but many of the cases he has related are represented to have occurred in adult and elderly persons[1]. Mr. Lawrence says, "I used to see it in children from two to ten years of age: it is not common in older subjects[2]." Mr. Mackenzie speaks of it as a "rare ophthalmia[3]." Of nearly 4000 persons suffering from diseases of the eye, who fall under my notice annually, about twenty-five are affected with the form of disease under consideration; and of this number, one only, on an average, is more than twenty years old. When the membrane of the aqueous humour is inflamed, the inflammatory action is not disposed to spread to contiguous parts to the extent we might suppose, from a knowledge of its great proximity to other delicate textures. But, if it continues for a long period in a severe form, the lamellar texture of the cornea, the proper substance of the iris, and the anterior hemisphere of the capsule, are generally inflamed, but not, I repeat, to any serious extent, unless indeed the treatment should have been very inappropriate or altogether neglected.

Symptoms.—1. There is generally a faint zonular arrangement of pink vessels around the cornea, not actually in contact with it except at a few points, and then only at the fully established stage of the disease[4]. The zone is by no means clearly defined; it is as a faintly tinted and not very distinct circle of minute pink-coloured vessels, the general surface of the eye not appearing vascular, except on a close and attentive inspection; then, indeed, both the conjunctiva and the sclerotica are found to be streaked with a few enlarged vessels, and communicate to the organ, when cursorily viewed at a short distance, a peculiarly dirty and unhealthy appearance. As the inflammation subsides, the zone appears patchy and imperfect, and becomes of a darker colour, inclining to purple, and sometimes leaves the sclerotica around the cornea a little discoloured, as though it had acquired an extremely faint olive-green tint. If, instead of declining, the inflammation should increase and extend to other parts, the red zone will be more bright, vivid, and distinct, (I allude to what may be termed a pure and clear colour as distinguished from a cloudy and muddy one,) and, should the lamellar texture of the cornea be materially involved, the white line situated between the margin of the cornea, and the zonular redness, will cease to exist.

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[1] *Ploucquet*—Litteratura Medica Digesta sive Repertorium Medicinæ Practicæ, &c. tom. iii. p. 217. *Breton and Twining*—Transactions of the Medical and Physical Society of Calcutta, vol. i. *Lawrence*—A Treatise on the Diseases of the Eye, p. 666.

[1] Medico-Chirurgical Transactions, vol. iv. p. 163.

[2] A Treatise on the Diseases of the Eye, p. 274. London, 1833.

[3] A Practical Treatise on the Diseases of the Eye, p. 472. London, 1830.

[4] In all cases where the corneal portion of the membrane of the aqueous humour is specially inflamed, I have observed that the arrangement of vessels exists quite at the margin of the cornea, and that no approach to a distinct white line intervenes between the pink zone and the corneo-sclerotic junction.

2. At a very early period of the disease the aqueous humour becomes cloudy—slightly turbid, as it is seen to be in many acute forms of ophthalmia; and, on a careful examination, it will probably be found that the lining membrane of the cornea is also cloudy, that the polish of the iris is impaired, and that the pupil has a dull and smoky appearance. The deep-seated cloudiness of the cornea cannot, however, be confounded with the "bluish-white," the "ground glass," the "dew-drop," the "*glace dépolie*," appearance of the cornea, which is noticed when the superficial portion of its lamellar texture is the seat of inflammation. In the progress of the disease a few minute milky spots are observed at various parts of the inflamed membrane, sometimes upon its corneal (and when in this situation they are very distinctly seen), sometimes upon its iridal, and sometimes upon its capsular portions; and these somewhat dense spots will occasionally be surrounded by a filmy streaky matter, possessing a degree of opacity, intervening between that of the mere general muddiness and the limited densely opaque spots to which I have just referred. It has been stated by Mr. Wardrop, that these dense spots are the result of an intense degree of inflammation of the lamellar texture of the cornea; but as they occur near and around parts of the inflamed membrane, remote from the cornea, I am rather inclined to consider them as the effects or products of the inflammation of the serous membrane merely, such as occur in inflammation of the same tissue in other situations. I am satisfied, however, that they are more manifest when existing in the corneal portion of the inflamed membrane, and that when unusually dense and extensive, it is extremely probable that such great amount of opacity is partly owing to the inflammation of a neighbouring portion of the corneal lamellæ. When the inflammation has existed for several days the cornea appears prominent, and there is a sense of tension and undue fulness of the eyeball. If we continue to trace the progress of the inflammation, we find that the pupil becomes irregular, somewhat contracted, and very cloudy, the surface of the iris rough, unequal and deprived of its polish, and that various changes take place, which will be hereafter mentioned as the effects of the malady.

3. There is seldom much intolerance of light present, but there is generally an increased secretion of tears, but not to the same extent as may be noticed in inflammation of the lamellar texture of the cornea or iris.

4. The condition of vision is, from the first, impaired, and this defect increases as the disease advances, until, aided by the diminution in the size of the pupil, but chiefly by various inflammatory depositions, it may be wholly destroyed. The tension of the globe, the nebulosity of the cornea, the turbidity of the aqueous humour, and the cloudiness of the capsular portion of its membrane, sufficiently explain the impairment of sight, even at an early stage of the malady.

5. The first sensation of any approach to severe pain arises from the plenitude of the anterior chamber, as manifested by the prominent state of the cornea, and the patient's account of his own sensations; but the disease is rarely attended by any great degree of intolerance of light, and may continue for a considerable period without occasioning much suffering. Pain over the eye-brow, and sometimes hemicrania, are complained of, but it is only occasionally that they acquire any distressing degree of severity.

Constitutional symptoms.—The general health of those who suffer from this disease, when it is idiopathic, has, in general, become impaired for some time before it occurs; so that it would almost appear that derangement of the health was, in a certain degree, necessary to its existence; derangement of the health is undoubtedly favourable to its occurrence. The symptoms of feverish excitement, and constitutional derangement, which may attend, or proceed from, the inflamed condition of the eye are very variable, depending, for the most part, on the severity of the ophthalmic inflammation, its degree of protraction, and the nature of the remedies employed for its removal.

Sequelæ.—The distention to which the cornea is subject in consequence of the increased exhalation from the inflamed membrane, has, under my own observation, occasioned near-sightedness, and conical cornea; but I am not aware that it has had any injurious effect, beyond this, except such as relates to the cloudiness of its lining membrane, and, perhaps, also of its innermost layer. The aqueous humour is, at first, merely turbid, but it soon becomes more materially changed. I have seen small filmy matters, and also distinct flakes and globules of lymph floating about in it[1], and, on a few rare occasions, a thin purulent matter has been secreted. Sometimes the whole of the corneal portion becomes thickened, and coated with a layer of lymph, or the chambers of the eye may be nearly filled with a deposition of lymph. Sometimes the iritic or capsular portions of the membrane alone are thickened, and rendered opaque, either wholly or partially. When the iridal portion of the membrane of the aqueous humour becomes opaque and thickened, the iritic texture has generally been involved in the inflammation, and its colour has undergone some degree of alteration. The pupil may be diminished, and rendered irregular, by the formation of frenular adhesions, passing from side to side, or by the formation of a filmy opaque membrane within its centre. The opacity and thickening, with deposition upon the capsular portion of the membrane of the aqueous humour, has been sometimes mistaken for the effect of inflammation of the anterior hemisphere of the crystalline capsule. I am convinced that this error is committed by some modern writers of celebrity. It will be borne in mind, that the secreting polished surface of the membrane of the aqueous humour is directed *from* the capsule of the lens, to which its less polished, vascular, and comparatively flocculent surface, is connected; having in this respect a precise analogy to the mode in which the free, polished, secreting, and the attached, flocculent, non-secreting surfaces of other serous membranes are related. A trivial degree of inflammation of the capsule of the lens, just sufficient to render its texture slightly opaque, generally occasions an increased secretion within its cavity, which is known by its bulging towards the pupil, and rendering the iris, but not the cornea, convex. I have many times removed a lens surrounded by a thickened capsule, and a quantity of turbid fluid; but then the opacity or layer of lymph-like matter is deposited on what was previously the polished, secreting, lenticular surface of the capsule, whilst in the case of acute inflammation of the capsular portion of the membrane of the aqueous humour, the lymph-like matter, when at all considerable, is situated on the *corneal*, not the *capsular*, surface of that membrane. Here, then, is a ground of diagnosis founded on the products of the disease, when acute, which I am satisfied is not sufficiently understood[1]. Other changes in the membrane of the aqueous humour, besides those I have enumerated, are stated to succeed either a prolonged attack, or repeated attacks of inflammation; of these I have only witnessed its conversion into a tough cartilaginous layer, or a distinct osseous lamina. These morbid alterations are, however, exceedingly infrequent.

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[1] The fixed globules of lymph noticed in inflammation of the true iritic texture are not observed when the capsule of the aqueous humour is inflamed. In the former case the secreted matters are confined and retained by the enveloping membrane; but in the latter instance they are, if liquid, at once secreted into the chambers of the eye.

Causes.—The causes of aquo-capsulitis are, for the most part, the same as those which give rise to various other forms of inflammation of the eye, and they will be referred to in detail, in the article Ophthalmia. I have witnessed the disease after contusions of the eye, after wounds of the cornea, and more frequently as a consequence of the operation of keratonyxis; and on several occasions, in children, from bathing in canals or shallow streams of water, remaining as they sometimes do, with the legs immersed in that fluid for half an hour together during the middle of a hot day.

Diagnosis.—See inflammation of the cornea, of the iris, and capsule of the lens.

Treatment.—In commencing the treatment, it is important to bear in mind, not merely the severity of the local symptoms, but the state of health and constitutional vigour of the patient. I have subdued the severest forms of inflammation of the membrane of the aqueous humour by means of quinine, with very slight alterative doses of mercury,—mercury *not* given to the extent of producing salivation—when the disease has occurred in feeble strumous children; and this plan of management I adopted and recommended at a time when, as far as I was able to learn, it was the customary practice to treat the disease by means of mercury, as for the cure of common iritis[1].

If the patient, though young, be tolerably strong, and if the inflammation be decidedly acute, it would be desirable to apply a few leeches immediately above the eye-brow, to recommend small doses of mercury in some of its forms, and, with any suitable combination, to be taken until the mouth is slightly affected. A small blister should be applied behind one or both ears, just as one or both eyes may happen to be affected; and it seldom happens that both eyes are diseased in anything like an equal degree at the same time. As a local application, I generally recommend either a poppy fomentation, an aqueous solution of opium (prepared by adding half-a-pint of boiling water to four scruples of powdered opium, allowing it to stand for twenty minutes, then filtering for use), or a weak goulard lotion. I further advise that a mustard pediluvium be used every evening for about ten minutes; that the patient's apartment be darkened; and that the diet be of a mild unstimulating character.

The necessity for bleeding, and for its repetition, will be determined by the constitution of the patient, the severity of the symptoms, and the influence it may, if previously tried, appear to exert upon the disease. To bleed a weak scrofulous child for the cure of a disease which is often obstinate in duration, and chronic in its nature, and which, also, is often protracted from the debility of the subject in whom it occurs, is, in fact, still further to prolong its existence. When extensive muddiness of the pupil is present, with merely a slight degree of inflammation, and more especially if the neural surface of the cornea is cloudy and opaque by patches, the best plan of management consists in the administration of four or five grains of the hydrargyrus c. cretâ every evening, with three or four grains of quinine, taken in divided doses during the day; and to these means may be advantageously added the formation of a small issue in the arm. Even in some apparently hopeless cases, where the chambers of the eye have been nearly filled with lymph, I have occasionally had an opportunity of witnessing the restoration of a very useful degree of vision, by continuing this plan of treatment, until the gums have become slightly tender; and then persevering in the use of quinine, and the occasional administration of mercury in smaller doses, until every portion of the lymph has been absorbed, except that which has become securely organized. On this system I have just treated, with great advantage, a poor woman suffering from this variety of inflammation. The inflammation was not remarkably acute, but the neural surface of the cornea was spotted here and there with portions of lymph. The persevering administration of mercury in a mild form, together with the sulphate of quina, restored to her a tolerably perfect state of vision, although her disease had resisted for several months the various plans of treatment which had been tried before I saw her.

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[1] I have lately attended a girl (Mary Bird, æt. 13, residing in Great Hampton Street), in whom the distinction referred to in the text may be very clearly witnessed. There is a nearly circular opacity within the pupil, which is somewhat smaller in size than that aperture; the opacity is by no means dense, but it is fixed; a few delicate filaments (which are scarcely visible to the naked eye) are detached from its lower border to the back part of the pupillary margin; and the opacity itself may be seen, as it appears to me, to be placed not upon the lenticular surface of the crystalline capsule, but upon the corneal aspect of the capsular portion of the membrane of the aqueous humour. The distinction between the two diseases (inflammation of the membrane of the aqueous humour, and inflammation of the crystalline capsule) may, therefore, in respect to this morbid phenomenon, be beautifully observed.

[1] Midland Reporter, vol. ii.; Medical Gazette, vol. viii.

In the cases of children who have been under my care, where the inflammation has been somewhat severe and protracted, and where the sulphate of quina has not been serviceable, I have prescribed, with great advantage, an evening powder, containing five grains of mercury with chalk, and three of rhubarb, and also from five to fifteen drops of liquor potassæ, to be taken twice a day. Such children have generally had a furred tongue, fœtid breath, and tumid abdomen, so that, before commencing the treatment, I have thought it desirable to evacuate the bowels pretty freely with castor oil. I have tried the internal administration of iodine, but it has not answered my expectations, although it has sometimes been useful as a collyrium. A small teaspoonful of the following drops, administered in water two or three times a day, may prove serviceable in cases where the habit is sluggish, the pulse slow and languid, and where the upper lip, tips of the ears, and alæ of the nose, are in a state of hypertrophy :—

℞. Tinct. Iodinii, ʒiss.
Vini Ferri, ʒxivss. Misce.

In adults and elderly persons, where the symptoms of the disease have not entirely disappeared after venesection and the use of mercury, and where quinine and various mineral and vegetable tonics have been prescribed in vain, I have derived advantage from the administration of the carbonate of iron, or small doses of turpentine, and in other instances colchicum has produced a very satisfactory effect, even when it has appeared almost necessary to relinquish in despair all further attempts to relieve. The indications for the one or other of these remedial agents are afforded by the characters and peculiarities of the constitution.

During the acute stage of the disease, when the aqueous humour is especially cloudy, the cornea tense, and apparently unduly prominent, the tunics of the eye-ball distended, and the frontal pain severe, it has been suggested to puncture the cornea and discharge a part of the aqueous fluid[1]. The immediate effects of this operation are certainly very agreeable, but, unfortunately, they are also very temporary, whilst the direct injury inflicted, and the pain produced by this surgical process, are very considerable. I do not now express any theoretical objection, but, on the contrary, advance an opinion which has been formed after having repeatedly adopted the practice I am reluctantly compelled to condemn. In the cases in which I have evacuated the aqueous fluid on account of inflammation of its secreting membrane, all the symptoms relieved by the operation have returned with equal and oftentimes increased severity, in twenty or thirty hours afterwards. The pain occasioned by the operation is very severe, for, in order to perform it properly, the eye-ball must be steadily fixed, and exposed to a pretty strong light. To do this simple operation on a healthy eye furnishes no correct guide to the trouble experienced when performing it upon an organ in a condition of acute inflammation. As, however, the practice is occasionally adopted, I shall give an account of the mode of performing the *operation.*

The patient should be placed upon a table, as for the operation of extraction, and it is found advisable to bind up the eye upon which it is not intended to operate, as a means of steadying its fellow. A cataract needle (sharp at the point, flattened and sharp at the sides, having a delicate groove running on that side of it opposed to the operator, when introduced with its flat side directed towards the iris, but not continued quite to its point,) is then to be passed through the cornea into the anterior chamber for a short distance, when the aqueous humour will spirt through the opening it has made. It is desirable that the instrument be so made that that part of it a little behind its point shall be so small as not quite to fill up the corneal opening, and that the point of the instrument shall not project far into the anterior chamber, lest the iris should be entangled and injured. The puncturing of the cornea does not much injure its texture, nor produce severe pain, but the unavoidable exposure of the eye to light, and the degree of compression of the eye required for the purpose of securely fixing it, occasion, in an acutely inflamed state of that organ, the most intense anguish.

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[1] This practice was first suggested by Dr. Whyte, (Med. and Physical Journal for March, 1802) for the relief of acute inflammation of the eye; it was, however, originally recommended by Mr. Wardrop, as a means of relieving the form of disease under consideration, in addition to its applicability to other varieties of ophthalmic disease. See his opinions upon the subject in the third volume of the Edinburgh Med. and Surgical Journal, and in the third and tenth volumes of the Medico-Chirurgical Transactions.

Hitherto I have confined my remarks to the more acute forms of inflammation of the membrane of the aqueous humour, but there is a chronic and also a strumous variety of the disease, to which it will be necessary to refer.

I have had occasion to witness a state of eye which has continued for a considerable time, and in which there have been no acute symptoms whatever. There has been a faint blush around various parts of the cornea,—in some places extending quite to its margin, in others, terminating a little anterior to its border; a few large trunks within the sclerotica have proceeded from the periphery of the globe at its directly upper, lower, and lateral parts, forming an interrupted and faintly marked and festooned vascular zone in that situation. There has also been a nebulous state of some part of the membrane of the aqueous humour, but no definite lymph-like patches, no pain in the eye or forehead, and no intolerance of light. Sometimes the anterior part of the eye assumes an appearance of undue plenitude, but this is by no means of frequent occurrence. This state of things (which I conceive to be chronic inflammation of the membrane of the aqueous humour) will sometimes continue for a long period. Its mode of treatment is very simple,—no active measures are required; counter-irritation may be continued in some convenient situation (the back of the ears or the temple are generally to be preferred) until the disease has nearly disappeared: hydrargyrus cum cretâ, with rhubarb, or some other medicine adapted to the improvement of the general health, may be administered[1]; and it will be most desirable not to employ the eyes in any way requiring minute vision, nor to expose them, unprotected, to the influence of a brilliant light.

Strumous inflammation of the membrane of the aqueous humour differs but little in its local characters from those of common inflammation of this membrane. The disease is, however, less acute in its symptoms, and generally of longer duration. Like other forms of scrofulous inflammation of the eye, it is often attended with great photophobia and profuse lachrymation. Under my own observation it has been successfully treated by the administration of the sulphate of quinine, and small doses of hydrargyrus c. cretâ, given until the mouth begins to be slightly affected. Counter-irritation, either in the shape of an issue in the arm, or an occasional blister behind the ears, is serviceable, or a slight degree of irritation may be maintained in the latter situation, by the infriction of the tartarized antimony ointment. The local applications I have found most serviceable have been a weak solution of hydriodate of potass (six grains to the half-pint of distilled water), or the goulard lotion (prepared by adding half a drachm of the liquor plumbi acetatis to half an ounce of the wine of opium, and half-a-pint of distilled water).

In conclusion, I would remark that, like all diseases which are very generally associated with derangement of the health or defect of the constitution, inflammation of the membrane of the aqueous humour is characterized by a great proneness to relapse, when it has once occurred, unless appropriate treatment be continued for some time after the appearances of inflammation have been dispersed, and unless great care be taken to prevent any undue use of the eye, more especially by artificial light.

(*Richard Middlemore.*)

ARCULUS, Lat.; *arceau*, Fr.; *Schutzplatte*, Ger. A semicircular hoop of wicker, wood, or strong iron wire, employed to protect diseased parts from the contact of the bed-coverings, or the shock of anything that may approach them. These cradles are in common use in hospital practice in cases of fractures, burns, erysipelas, &c. Their use was once prescribed by law in the states of the Grand Duke of Tuscany; it being forbidden to nurses to sleep with their infants unless they protected them in this way from being overlaid during sleep.

ARGENTI NITRAS, the nitrate of silver. The crystallised salt is almost exclusively confined to internal administration. In the fused form, lunar caustic, (*nitrate d'Argent fondu*, *pierre infernale*, Fr.; *Geschmolzenes salpetersaures Silver*, *der Höllenstein*, Ger.;) it ranks as one of the most generally useful applications employed in surgery. Both as an escharotic and a stimulant its effects can be nicely graduated; the pain arising from it is in general slight, and of short duration; yet it acts promptly and decisively, at the same time that its chemical operation upon a part renders absorption impossible. The nitrate of silver is not, however, to be regarded merely in the above-mentioned characters, since it exercises a marked influence, as Mr. Higginbottom has shown, in the resolution of superficial inflammation, exemplified in the effects produced by it on congested vessels of the conjunctiva and other mucous membranes, and in the power it sometimes exhibits of arresting erratic erysipelas and inflammation of the absorbents. This seems rather to depend on its astringent or tonic properties, or on some peculiar power exercised by it on the capillaries; perhaps, in some measure, on the serous effusion and vesication it excites.

It is employed externally in the solid form or in a state of solution.

For convenience of manipulation, the solid stick or cylinder of nitrate of silver is securely fixed in a silver tube or case with a handle attached to it. If the surface to which it is about to be applied is dry, it must be moistened; the nitrate is then passed over it with more or less rapidity and frequency according to the sensibility of the part, or the effect we are desirous of producing, leaving the surface exposed, wherever that is possible, until it is dry. The eschar, or pellicle, resulting is superficial on the skin, and still more so on the mucous membranes: in the former case it gradually changes from a light silvery hue to black; and unless much vesication has been excited, separates from the cutis, and peels off about the fifth or sixth day.

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[1] To avoid repetition, I purposely abstain from an elaborate consideration of various means of improving the general health (such as clothing, exercise, air, &c.) in the present article.

The solution is best applied by means of a camel's hair brush or a fine pencil of lint; for conveying it to the back of the fauces, pharynx, &c., the sponge attached to the probang is well adapted.

The solid lunar caustic is most commonly resorted to for the purposes of repressing exuberant granulations, suspending the progress of certain gangrenous affections, destroying warts, corns, condylomata, &c., and removing the callous edges of indolent ulcers, to the surface of which it is also applied with the view of inducing cicatrization. (See art. ULCERS.)

A coating formed by it over excoriations of the skin of the sacrum, in bedridden patients, affords an excellent defence to the abraded surface, which will frequently cicatrize beneath it.

A similar treatment of superficial burns and scalds has long been successfully followed by Dr. Fricke at the General Hospital of Hamburg.

It is employed with advantage in chronic inflammation of the conjunctiva, in ulceration of the margin of the eyelids, and in ulcerations of the cornea, with or without protrusion of the iris; the precaution of immediately letting fall a drop of sweet oil upon the spot will prevent its diffusion over the rest of the organ.

It is serviceable in checking the ravages of lupus and cancerous ulcerations of the face; and will be found useful in all inveterate ulcerations, as those, for instance, which occur about the nails. Mr. Higginbottom strongly recommends it in the early stage of whitlow, and even after suppuration has taken place, first evacuating the matter. Also in Housemaid's Knee (inflammation of the bursa mucosa of the patella). In all cases of abscess, however, the coating produced by nitrate of silver is likely to be injurious, by impeding the progress of the pus towards the surface, and causing it to burrow in search of a distant outlet.

The propriety of its application to chancres is disputed by some practitioners, although strongly insisted upon by others. (See SYPHILIS.) Dr. Fricke, of Hamburg, is an advocate for its employment in the form of an ointment, which is left in contact with the sore for two or three days. His formula is as follows :—℞ Argent. Nitr. Cryst. pulv. ℈ss. Ung. Zinci ʒij. Bals. Peruv. ʒss. ɱ diligenter.

In croup, and especially in chronic inflammation of the mucous membranes of the fauces, pharynx, and nasal fossæ accompanied by adherent sloughs or false membranes, its use is attended with very beneficial results; the adventitious surface becomes dry, separates, and leaves the membrane beneath healthy. Of its successful application, with similar views, in thickening of the membrane lining the meatus auditorius externus, Mr. Earle has reported instances in the Medico-Chirurg. Trans. vol. x.

Aphthous ulcerations of the mouth, also, heal readily under its influence.

In the treatment of stricture of the urethra, the success obtained by Hunter, Home, and Whately, in this country, and by Ducamp, Lallemand, and others, on the Continent, have established its claim to merits of a high order. (See STRICTURE.)

M. Desportes has been led by analogy to apply it to the cure of obstructions of the nasal duct.

By destroying their edges, or internal lining, and surrounding their orifices with an eschar, the nitrate of silver will often bring about the contraction and cicatrization of fistulous openings. We may rely upon it, in the majority of cases, for suppressing prolonged hæmorrhage from leech-bites, or from the gums after extraction of teeth; and, in solution, it is frequently efficacious in putting a stop to chronic hæmorrhages.

Solutions of various strength are used as injections in gonorrhœa and leucorrhœa; also, in puriform discharges from the meatus auditorius, ascertaining first, that the membrana tympani be sound; as an application to the excoriated nipples of nursing mothers, in which it affords immediate and permanent relief; and as collyria in superficial inflammations of the eye. (See articles on those subjects.)

(*Henry T. Chapman.*)

ARM, BEND OF. Under this title will be described the elbow-joint and all the important surrounding parts which are within the arbitrary limits of about two inches above, and two inches below, the centre of that articulation. Many objections may be made to the words which head this article; nevertheless they appear to us less objectionable than most others. In fact there is great difficulty in finding appropriate denominations for this branch of surgical science, owing partly to the want of precision in many of our English anatomical expressions. Some might prefer calling this portion of the upper limb "the region of the elbow:" this name, however, has been very differently and very improperly used; its strict anatomical meaning is the back part of the arm-joint, formed principally by the posterior and superior extremity of the ulna. Thus William Cowper[1] speaks of

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[1] Myotomia Reformata, p. 177. London, 1724.

"the olecranon, or elbow." Most authors follow this example, and employ the phrases, "bend of the elbow-joint[1]," "bend of the elbow[2]," "front of the elbow[3]," &c., to denote the fore-part of the arm-joint. Some authors apply the word "elbow" incorrectly, as thus: "all recent dislocations of the elbow[4]," which agrees exactly with Dr. S. Johnson's[5] singular definition of "*elbow*,"—"the next joint or curvature of the arm below the shoulder." The best continental writers seem also to have experienced some difficulty in choosing terms for defining this region: hence they differ considerably. M. Gerdy[6], for instance, in his interesting and laborious work, has described the superficial parts of the bend of the arm in his chapter "On the articulation of the elbow." M. Velpeau[7], in the last edition of his surgical treatise, makes a "humero-cubital region," which he divides into two sections; the one is the bend of the arm, or the fore part of the limb; the other is the elbow, or the back part, which comprises the two tuberosities of the condyles of the os humeri, the olecranon, and the parts situated upon or around these points. M. Blandin[8], whose work, if not the best upon this matter, is certainly the most surgical and practical, describes this part under the head of "region of the elbow." M. A. Berard[9] has adopted the same plan, and M. Malgaigne[10], in his new volumes, approves of that arrangement, but calls its posterior surface the "olecranion region." M. H. M. Edwards[11] has improperly confounded this important region with the arm and fore-arm, in his "middle region of the arm." Mr. Lizars, in his little book, which is entirely anatomical, nearly follows the same order, making no separate region for the elbow, but describing it in his "anterior and posterior brachial regions[12]. B. G. Seiler, the distinguished anatomist of Dresden, has also spoken of this region when treating generally of the "anatomia extremitatum[13]." The thesis quoted in the note, like Lizar's little book, gives a sort of catalogue of the subjects, comprehending surgery as well as anatomy, which should enter into a course of lectures upon this matter. This modest and learned production, which I have never seen noticed by any writer, shows that its author was perfectly aware, even at that early period of his career, of the utility of surgical anatomy, and how it ought to be prosecuted to become useful to the surgeon. Indeed it is surprising that Seiler's "Outlines" did not stimulate his laborious countrymen to complete a work upon that plan. To this day, however, no such treatise of any importance has appeared in Germany. In England, France, and America surgical anatomy has been cultivated more extensively, as well as more successfully; a circumstance which may reasonably be explained by surgery being more advanced in those countries than elsewhere. Without endeavouring to prove the impropriety of many of the denominations which have been used by the able writers above mentioned, it is sufficient to know that they have all given a more or less comprehensive description of this region; and as we strongly recommend the perusal of these works for the valuable information they contain, we shall make a point of correcting any errors which may have escaped their authors.

The arm, on account of its being constantly in action in the various pursuits of pleasure or of toil, and also on account of its peculiar situation, detached from the body, and increasing its lateral dimensions, is continually exposed to injury. The bend of the arm, in particular, claims the student's care, as the region in which his anatomical skill is generally first tested in the operation of bleeding; it being considered a fair and easy trial for his young hand, although no operation is at times more trying, or more liable to be followed by serious consequences. The bend of the arm is also the seat of a number of diseases, often very complicated in their nature, and requiring great attention and manual dexterity from the surgeon; and on these grounds, therefore, the greatest care ought to be bestowed on the description of this region. The outward forms, so worthy of being thoroughly studied by the practical surgeon, and which nevertheless have been so greatly neglected, and so imperfectly understood, we shall also endeavour to explain.

As this region varies its form with every change of position, the type of our description will be the arm extended, and the hand in complete supination; this being also the position of the limb during the performance of most surgical operations in that part. There are four sides or surfaces to this region:—the anterior, or bicipital; the posterior, or olecranial; the external, or radial; the internal, or ulnar. The bend of the arm presents great variety in form, size, and proportions, at different periods of life. Thus the three stages of infancy, full growth, and old age have each its peculiarities, which, for the acute observer of the human form, are sufficient to distinguish them from each other. The divers pursuits of mankind likewise produce many changes which are not without interest. The difference of sex is another great cause of diversity in the form of this region; but as it would be impossible to do justice to these points without incurring the blame of treating the subject more for the artist than for the surgeon, we shall content ourselves with pointing out the most important practical bearings connected with them, taking our description from the male adult arm, in which nearly all the parts are upon a larger scale, and more palpable to the anatomist than in the other periods of life, or in the other sex.

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[1] The Elements of Anatomy, by Dr. Jones Quain, p. 330. London, 1836.

[2] Dublin Dissector, p. 117; a very good manual of Anatomy, by R. Harrison. 1836.

[3] Dr. Todd's Cyclopædia of Anatomy and Phys. Art. ARM, p. 217; by John Hart.

[4] Cooper's Dictionary of Practical Surgery, p. 403. London, 1830.

[5] English Dictionary, fol. ed.

[6] Anatomie des Formes Extérieures du Corps Humain, p. 180. Paris, 1829. "De l'articulation du coude."

[7] Traité Complet d'Anatomie Chirurgicale, tome ii. p. 411. Paris, 1837. 3rd Edition.

[8] Traité d'Anatomie Topographique, p. 515. Paris, 1834.

[9] Dictionnaire de Médecine, 2de Edition, tome ix. p. 204. Art. COUDE.

[10] Traité d'Anatomie Chirurgicale et de Chirurgie Expérimentale, tome ii. p. 441. Paris, 1838.

[11] Manuel d'Anatomie Chirurgicale, p. 272. Paris, 1827.

[12] Heads of Demonstrations on Regional Anatomy, p. 111. Edinburgh, 1836.

[13] Page 22 of his Commentatio Primas Lineas Prælectionum Anatomiæ Chirurgicæ complectens, &c. Vitebergæ, 1802.

The bend of the arm, especially in the male, has a somewhat irregular shape, presenting several prominences and depressions. The antero-posterior diameter is much less than the lateral or transverse, which reaches from the radial to the ulnar side. The fore-part, or front surface of this region is flattened or hollowed about its middle; the posterior and lateral sides, on the contrary, are convex. The middle anterior depression is of a triangular shape, more so when the integuments are removed, and contains the most important parts in this region. This depression is continued up the arm on each side of the biceps, and gives that flattened shape in the male arm which is scarcely perceptible in females, owing to their osseous and muscular systems being less developed, and to the greater abundance of adipose substance, which fills up all the depressions, and gives their limbs that beautiful rotundity which constitutes the peculiar charm and grace of the female form. The posterior side of this region forms the elbow; in its middle a bony projection, called the olecranon, may always be seen or felt. The external or radial side extends from the middle depression, is convex, and surrounds the radius; it projects much beyond the outer line of the arm, which makes the upper part of the fore-arm much wider than the arm itself. The inner or ulnar side also commences from the middle anterior hollow of this region, is likewise convex, and presents a bony prominence, called the tuberosity of the inner condyle of the os humeri, which is always visible, or easily felt by the fingers, and gives great character to the male arm. On each side of the olecranon are two distinct and well-marked depressions or furrows, which may be denominated the radial and ulnar depressions; but their description will be more fully given when the deeper parts are examined. There are also some other furrows, which merit notice, and will be explained hereafter. These outward forms have rarely been correctly delineated by the great masters of painting; however, some of the modern French school, and we must place David, Ingres, and De la Roche among the first, have given the most splendid specimens of correct anatomical drawing [1].

The skin at the anterior surface of the bend of the arm is very thin and smooth, contains merely fine small hairs, and presents a number of transverse folds or lines, caused, as at the knee, foot, wrist, &c., by the continual flexion, or bending of the part. In fat persons, in women, and in young children, there are one or two well-marked lines, which extend across this region. Owing to the delicate nature of the skin in this place, the veins are frequently perceptible, by their colour appearing through the integuments, and by their rising above the surface, and thus marking their course. The skin is thinnest at the middle of this region, becoming somewhat thicker as it proceeds from this spot: here, also, it is more vascular, and contains a greater number of superficial nerves, which are principally branches of the intercostal and musculo-cutaneous nerves, than at the other sides of this region. The delicacy of its texture may help to explain the frequency with which many diseases, such, for instance, as herpes, ezcema rubrum, and prurigo, manifest themselves in this part. That singular insect, the acarus scabei, seems to show a decided predilection for this situation. During the extended state of the arm, although the skin is not very loose, it may nevertheless be pinched up into folds. At the posterior surface, or elbow, it presents a number of small irregular folds, which are most marked in strong men, and in whom the olecranon is always very prominent. The cuticle is very rough to the touch, owing, apparently, to a scaly state of the epidermis. When the fore-arm is bent upon the arm, this rough surface becomes quite smooth and tense, and is generally tinted with a reddish hue. During the extended state of the limb, the fingers may grasp a large fold of the skin, but by pulling it, even forcibly, no tension of the integuments in front of this region can be produced: this is explained by the strong adhesion of the skin to the fibro-cellular sheath which surrounds the bursa mucosa, and attaches itself to the olecranon, and to the tuberosity of the condyle of the os humeri. This fact equally accounts for large tumours in this region not affecting the skin in front of the arm. Owing to these adhesions of the skin to the fixed points beneath, it is important in all surgical operations to remove as little of it as possible, as otherwise there would be great difficulty in bringing the lips of the wound together. On the outer or radial side the skin is thicker, and mostly covered with hairs; on the ulnar side the skin is soft and thin. By pinching up a fold, and pulling it forwards, it will be found to connect itself to the tuberosity of the inner condyle of the humerus.

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[1] Girodet's picture of the "Deluge" is a sort of view of the three great varieties in the human form. Here we see the aged father's sinewy arm clasping the neck of his athletic son, who bears him upon his back, while the son's right arm saves his fair companion from a watery grave: a young boy and a babe, supported by their mother's arms, complete this well-drawn group. Among the Grecian statues there are a great many astonishing representations of this difficult region; none, perhaps, are more perfect than those of the "Knife Grinder" and the "Boxers" of the Tribune, the "Dying Gladiator" of the Capitol, and the "Gladiateur Combattant" of the Louvre.

Immediately underneath the skin, and adherent to it, is a very important layer of adipose tissue, which presents many points worthy our notice. It is generally, though erroneously described as surrounding the bend of the arm. It abounds chiefly in the front of this region, and is most developed in young children and females. In this situation it forms a sort of cushion, which covers the veins, and frequently prevents their being seen; by its softness and yielding nature it must likewise prevent any sudden or undue pressure upon the nerves and blood vessels, and in the same way diminish the ill effects of violent muscular contractions. From the abundance of adipose tissue, especially in females, the surgeon often finds great difficulty in performing venesection. Sometimes a small quantity of fat protrudes through the puncture made by the lancet, which prevents the proper flow of blood, causes thrombus, and is often followed by slight suppuration of the wound. When this accident occurs, the surgeon should be particular in returning the protruded part, or to remove it by cutting it away with the blade of his lancet, and close up the wound carefully. The posterior surface of this region, or elbow, contains very little fat; and why this difference? Is it not because there are here no important parts to guard! We never see, even in nature's sports, any large vein or artery passing superficially in this course, and requiring protection. The ulnar nerve can hardly be considered an exception; it is not strictly superficial; it lies in a groove, which is well protected by two bony projections. An accumulation of adipose tissue, far from improving the structure of this part, might produce considerable impediment to the free motions of the elbow-joint, and be the source of numerous diseases.

Nevertheless the skin at the elbow evidently requires particular protection, to prevent its being frequently bruised by sudden and violent pressure against the hard and resisting surface of the olecranon. This is done by means of a bursa mucosa, which allows great mobility of the skin, and effectually prevents many injuries that otherwise must occur from blows, &c. The adipose tissue, which is found in abundance at the lower and back part of the arm, almost suddenly disappears opposite the upper end of the ulna; hence, also, in corpulent persons, instead of the olecranon forming a slight and natural projection when the limb is extended, a hollow is observed, the fat accumulating around that projection, and rising above its surface. In several other points of this region the fat is also scanty, particularly upon the external condyle of the humerus, and opposite the head of the radius. This might also appear an imperfection in the conformation of the limb. It must be remembered, however, that these bony surfaces are round and smooth, and allow the skin to roll over them with the greatest ease, without even the assistance of a synovial membrane. This almost total absence of fat opposite the articulation of the head of the radius is in a great measure the cause of that depression, called in popular language the "dimple of the arm," which in babes is only large enough to contain a pea. In females of fine mould it is much larger, and gives a peculiar charm to the arm it adorns. M. Gerdy (Op. cit. p. 187) has not rightly explained the cause of this depression. He attributes it almost entirely to the muscular radial eminence. Owing to the want of adipose tissue, the surgeon should avoid applying much pressure upon the integuments in these situations, lest their vitality should be destroyed. The radial dimple may be filled up by the head of the radius when dislocated backwards, and the skin may be exposed to ulceration by that bone pressing against it. The tuberosity of the inner condyle of the humerus is another point where no fat is observed; a soft cellulo-fibrous substance occupies its place, and assists the skin in sliding over it. This displacement of the skin is easily seen during flexion of the limb, by marking it with ink, and following its displacement with the eye.

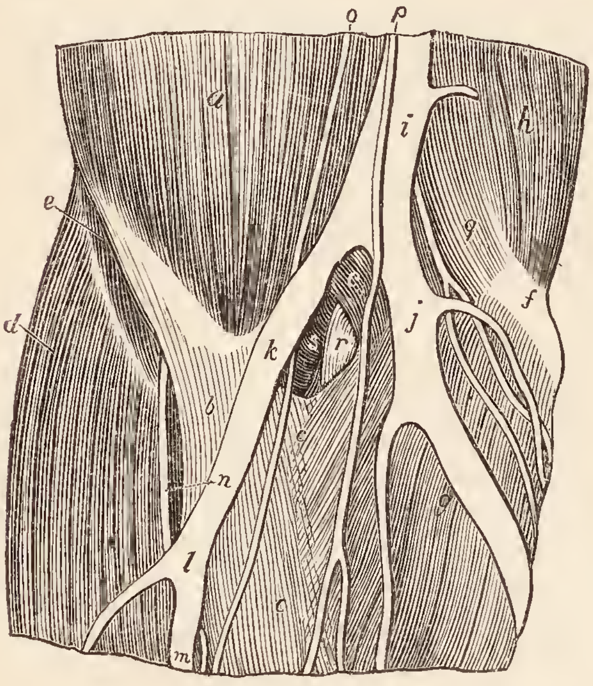
The adipose substance in front of this region is frequently the seat of various forms of inflammation, especially phlegmonous erysipelas following venesection. Sometimes suppuration affects the fat which surrounds the veins in the form of canals. The matter may be pressed out of the wound made by the lancet, and has often been supposed to proceed from the veins themselves.

Lipomatous tumours are sometimes met with in front of the region of the elbow: their removal requires great prudence. In fact the surgeon ought never to make an incision in this situation without first applying a bandage round the arm as if he were going to bleed the patient. He will thus be able to mark down with ink, if he thinks proper, the exact course of the larger veins; indeed this precaution should always be resorted to whenever an operation is performed upon parts where the most perfect knowledge of anatomy cannot, either from irregularity in the organs, or from various displacements by tumours or other diseases, avail in establishing their precise situations. I have several times witnessed the value of this practical truth. A patient with abscess of the neck came under M. Lisfranc's care at the hospital of "La Pitié." This gentleman gave a lecture upon the safest manner of opening such tumours, when surrounded by important organs. He did not tell his pupils to endeavour to note down the precise course of the large veins. He ordered his assistant to plunge the bistoury into this abscess, which was immediately followed by a gush of venous blood. The external jugular vein was injured : an accident which might perhaps have been avoided by the simple precaution indicated above.

A thin superficial cellular fascia lies immediately beneath the layer of adipose substance, covering the veins and subcutaneous nerves, and united to the common aponeurotic sheath by fine cellular tissue. This superficial fascia is not always very distinct ; it is seldom strong : nevertheless it merits notice, as will be shown when the veins are described.

The veins in front of this region are very irregular, and seldom represented alike in anatomical drawings. Their names even have often been changed. The principal varieties in these vessels may be classed in the following order :—1st, The veins in both arms are rarely alike. 2ndly, They may be more numerous than usual, and then the larger trunks will be found smaller than natural ; or they may be diminished[1] in number, but larger than ordinarily. 3rdly, They may be regular as to number, but changed in their positions. 4thly, Or they may be irregular in number, in position, and in size. The cutaneous and subcutaneous veins of the arm (as well as of every other part of the body) can be beautifully injected by the medium of the aorta, or brachial artery. I lately saw, at Leipsic, a splendid preparation made in this way, and under the direction of that distinguished anatomist, Prof. E. H. Weber.

Fig. 108.



This sketch represents several common varieties in the number and position of the veins and musculo-cutaneous nerves. The median basilic vein will be seen to follow nearly the course of the brachial artery. a, The biceps muscle of the right arm. b, The biceps tendon giving off the "fascia tendinosa," e e e, which has been opened to show the exact situation of the brachial artery s, and median nerve r. d, Supinator radii longus. e, Brachialis internus muscle, which sends off an aponeurotic expansion in this situation. f, The tuberosity of the inner condyle of the os humeri. g, The common aponeurotic sheath of the fore-arm which, in this point, covers the pronator. R, Teres muscle. h, The triceps muscle. i, The basilic, or "axillaria externa" vein. j, The cubital or ulnar vein. k, The median basilic vein, or mediana communis. l, The point where the "vena communicans" joins the radial vein m, and the median basilic, and cephalic vein, which, in this arm, was entirely wanting. n, The external musculo-cutaneous nerve, which is almost constantly regular in its situation. o, Outer branch of the internal musculo-cutaneous nerve. p, and q, Inner branches of the same nerve passing before and behind the veins. r, Median nerve. s, Brachial artery.

Great confusion in the names of these veins has been caused by modern writers changing the old nomenclature, and sometimes by applying the same name to very different veins. Dr. Jones Quain has given a confused description of these vessels in his manual of Anatomy (p. 579). He dislikes the terms "basilic and cephalic," "*which serve no useful purpose.*" It is somewhat singular that this anatomist should have chosen an irregular distribution of these veins in his collection of drawings[1], which a student might in vain endeavour to understand by referring to the above-named manual.

As the student may frequently be perplexed when he refers to different writers for a complete knowledge of these veins, we shall briefly explain these difficulties. The nomenclature of these vessels was formerly very simple. Thus that able anatomist, Camper, has given an excellent description of the superficial veins and nerves of the arm, and has enriched his work with two beautiful line-engravings, which represent these parts in their most ordinary form. Camper employed the most common names in use : thus ; he calls the cephalic vein the "vena humeraria, vel cephalica," which he describes as arising from the fore-part of the wrist, then running along the front of the fore arm, and uniting at the bend of the elbow to the "mediana simplex," now called the median basilic. Here it also receives one or more external or radial branches, and then proceeds up the arm to the clavicle. Therefore this humeral or cephalic vein corresponds to the "median vein," to the "common median vein," to the "anterior radial vein," to the median cephalic and cephalic veins of recent writers[2]. The radial veins are considered merely as branches of the cephalic vein.

The "basilic, or axillaria externa," is formed by the anterior and posterior cubital veins, which, at the bend of the arm, unite together and form a short and large trunk called the basilic, which is also joined to the cephalic by a large vein, which from its position was formerly named the median vein of the arm; it is now known by the name of "median basilic." The largest and most regular, and most superficial vein, is the median basilic; M. Cruveilhier[1] nevertheless assures us, that the median cephalic is larger. M. Gerdy[2] has compared the most regular distribution of these veins to the form of the letter M, the two upper extremities of which would give off the cephalic and basilic veins, the three lower extremities would receive the radial, the common median, and cubital veins; the two middle strokes of this letter represent the median cephalic and median basilic; this comparison may facilitate the recollection of the most regular distribution of these veins, although, according to M. Lebaudy[3], this "regular disposition" of the veins of the arm will be sought for in vain. In describing these veins, authors have not paid sufficient attention to one called the "communicating vein," which we consider a very important vessel, and seldom wanting. M. Velpeau[4], in speaking of this vessel, says, "the median vein divides into three branches, the first is very short, and called by M. A. Berard[5] the perforating vein: it empties itself directly into the deep seated veins, in the same way that the saphena vein does into the crural vein." This comparison is not quite just; the saphena vein throws its blood into the crural vein, whence it cannot return, owing to the existence of valves which prevent this retrograde motion; in their diseased state, these valves may become "*insufficient*," and hence those fatal hemorrhages from bursting of the saphena varicose vein. Instead of considering this vein a superficial vessel, it is more correct to view it as a deep-seated vessel, which unites these two order of veins; the blood also flows from the deep into the superficial veins of the arm; and here again the analogy with the saphena vein fails. We prefer calling this vessel the "vena communicans," a name used by all the best writers and more correct than the one lately proposed by M. A. Berard. In our dissections we have always found this vein existing, and always in the same situation, at the outer side of the tendon of the biceps muscle, in that ridge formed between the pronator R. teres[6] and supinator R. longus muscles, where an opening in the aponeurotic fascia allows it passage, and which is probably somewhat enlarged during the contraction of the biceps muscle, as M. Berard justly remarks, owing to the peculiar arrangement of the "fascia tendinosa bicipitis." I have seen this vein when the median vein was absent; in other cases when the cephalic was wanting. I have never observed it on the inner side of the arm, although I have made repeated dissections of this vein; in fact it appears much more regular than the other veins of this region. When closely examined, this communicating vein will appear to be formed by the trunk of the deep-seated radical vein, which passing through the aponeurotic opening, throws itself principally into the median basilic vein. This seems to be the case in M. Lebaudy's plate, in which it is well delineated; sometimes, on the contrary, it empties itself mostly into the median cephalic vein: it often contributes greatly in increasing the size of both these veins, as may also be observed in Dr. Quain's plate. The great purpose of this vein is to form a communication between the superficial and deep veins on the outside of the biceps tendon, an empty space existing between the muscles, which allows the blood to pass uninterruptedly from the large and deep to the superficial veins, by means of this communicating vessel: this vein is also provided with valves which prevent the blood returning from the superficial to the deep veins, which is another reason for not comparing the saphena with the communicating vein. The saphena might with more propriety be compared to the basilic vein, which perforates the aponeurosis of the arm, and discharges its contents into the deep vein. It is a common practice during the flow of blood from the vein of the arm, to order the patient to work his fingers, when at each motion the blood will generally jerk out with new vigour, and in a larger stream; in moving the fingers, the flexor muscles contract and propel the blood from the deep-seated veins into the communicating branch. Many persons account for the increase of the stream of blood by admitting numerous anastomosing branches between the superficial and deep veins of the fore arm; but where are these branches found? Besides, the superficial veins are supposed to send their blood into the deep veins; to say nothing of their being little influenced by muscular contraction, which evidently takes place beneath them; the blood sometimes does not jerk out by working the fingers; how is this explained? Simply because the lancet has opened some vein which does not receive blood from the communicating vein. When the veins of the arm are small, and the surgeon finds difficulty in feeling them, we strongly recommend him to order his patient to "work" his fingers forcibly; this will distend the veins with blood, and allow them to be better opened by the lancet.

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[1] See Fig. 1.

[1] See plate 36 of a Series of Anatomical Plates, &c. Fasciculus 42. London, 1837.

[2] Refer to "Heads of Regional Anatomy," by A. J. Lizars, p. 112; Bourgery's Traité d'Anatomie, plates 37, 61, 63. See also Meckel, Bichat, Boyer, Weber, Harrison, Blandin, Velpeau, Malgaigne, &c. &c.

The ancients supposed the cephalic vein went to the head, hence its name. The basilic vein of the right arm was anciently called the hepatic vein; while the basilic of the left arm was termed the splenic vein, from an erroneous notion of a great sympathy between them and the liver and spleen. Hence, also, the preference they gave in bleeding to the one or to the other vein, according to the organ diseased.

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[1] Anatomie Descript., tome iii. p. 299.

[2] Anatomie des Formes, &c. p. 183.

[3] Anatomie Médicale et Chirurg., p. 95, dans Journal des Con. Medico-Chirurg. Paris, 1833.

[4] Anatomie Chirurgicale, tome ii. p. 421.

[5] Diction. de Médecine, 2nd edit., tome ix. p. 217.

[6] Peter Camper has not delineated this vein in his beautiful engraving of the arm. M. Lebaudy, in his sixth plate, has given a correct representation of this vessel. My learned friend M. Velpeau has omitted this view in his fourteenth plate, which is badly executed, all the parts being pulled out of their natural position. Dr. Jones Quain, in his 36th plate, fig. 1, (Series of Anatomical Plates,) represents the vein on the inside of the biceps tendon, uniting itself to the median cephalic and basilic, there being no median superficial vein, which, as in M. Velpeau's case, does not agree with the description of these vessels found in their own books. M. Blandin, in his plate, has also given a poor and imperfect delineation of this vein, plates xvi., figs. 1 and 2. M. Bourgery, in plate 61 of his great work on anatomy, has given a very confused drawing of this vein, which he calls "the anastomosing branch of the confluence of the superficial and deep-seated veins." M. Malgaigne, like MM. Blandin, Berard, and Velpeau, considers this a superficial branch, which springs from the "*two median cephalic and basilic veins, and empties itself into the humeral artery*." Our author seems to have written this work in great haste, which accounts for his not correcting this singular mistake of *artery* instead of vein. See Op. cit., p. 444, tome ii.

There are several interesting points regarding the situation of the veins of the arm worthy of the surgeon's attention, and which are generally neglected. These large veins always pass over the front of this region; are more or less concealed by fat, and lie under a superficial fascia of cellular substance which sometimes is pretty thick and always loosely connected to the aponeurotic membrane enveloping the fore-part of the limb; for this reason they are not strictly subcutaneous: M. Cruveilhier[1], however, conceives that the median basilic vein frequently forms an exception to this rule, and that it "*lies in a great many subjects*" immediately under the skin. There are likewise many precautions necessary in the operation of blood-letting, which are nearly connected with the relative anatomy of the veins. Among the most common accidents which follow blood-letting, we may safely place first, inflammation of the vein and the tissues around it; this inflammation is frequently phlegmonous, and extends some distance above and below the elbow, and may end in suppuration. These accidents cannot often be traced to any negligence on the part of the surgeon; too much care cannot, however, be observed, in closing the opening of the vein with fine linen or sticking plaister, so as to prevent any irritating friction upon the edges of the wound. Thrombus and ecchymosis are still of more frequent occurrence, but they scarcely merit notice.

Surgeons formerly supposed that there was much danger to be apprehended from wounding the aponeurotic fascia of the arm and the tendon of the biceps muscle. They attributed many symptoms to such injuries which pathologists now ascribe to the pricking or the dividing of the nerves. It is therefore of importance to inquire whether there be any means of preventing those accidents. The nerves most liable to be punctured or divided in bleeding at the arm, are, the musculo-cutaneus internus, the small twigs of Wrisberg's intercostal nerve, which follows the basilic vein and loses itself in the integuments, the musculo-cutaneus externus, the median nerve, and the radial nerve. I have made repeated dissections of the nerves with a view of comparing their relative situations with respect to the veins; the result of these investigations is, that the internal musculo-cutaneous nerve is as irregular in its divisions as in its situation; it sometimes passes in front, sometimes behind the veins, sometimes on their inside, sometimes on their outside; sometimes its branches run towards the middle or even to the outside of the arm, when it generally anastomoses with the external cutaneous nerves; sometimes no anastomoses take place between these two nerves until they reach the fore-arm[1]. Camper has given a very correct delineation of these nerves, which he does not make anastomose at the bend of the arm, and I am inclined to consider this the most common distribution. Neither does M. Lebaudy, in his plates, show any anastomoses between these nerves, which are about twice too large, *although* that author call his drawings "*de grandeur naturelle.*" M. Velpeau[2] represents no anastomosing branches, and places the cutaneous nerve on the outside of the basilic vein; in his book, however, (page 420,) this nerve is described "as being enclosed in the same sheath with the basilic vein, *and almost always on its inside.*" M. Gerdy[3] says that "the cutaneous nerves are always liable to be injured by the lancet, owing to the anastomoses between the internal and external cutaneous nerves; this accident produces instantaneous and acute pain, which extends to the fingers." We cannot agree with M. Gerdy, who seems to consider the anastomosing nerves as being generally wounded; nor does it appear necessary that acute pain should follow immediately their injury, a point which further observations will explain. The same distinguished writer likewise maintains that there is greater danger of puncturing the nerves, the nearer the lancet approaches the sides of the arm; an opinion which our dissections do not corroborate. We think it may be established as a general principle, that there is less risk of wounding the internal cutaneous nerve, the nearer the lancet punctures the centre of the basilic, median basilic, and cubital veins, in a parallel direction with those vessels. This will appear evident by casting a glance over the little sketch of these veins and nerves which we have given, and where the ordinary course of the nerves may be observed running mostly alongside and in the same direction as in the veins. The external musculo-cutaneous nerve is very regular in its situation, and almost always lies on the outside of the biceps tendon, behind the cephalic vein, or perhaps more frequently on its inner side; however, as it proceeds towards the "vena communicans," where it divides into several branches, it mostly passes on the inside of this vein. M. A. Berard, on the contrary, says it passes on the outside of the vena communicans. See p. 214, Dict. de Méd. cit.

I have also found this nerve on the outside of the vein; I have never seen it pass in front of the median cephalic vein; and as it is deep-seated and regular in its course, the best way to avoid cutting it, in bleeding that vein, is to open the vein in its middle, taking care not to plunge the lancet too deep, lest it should run through and through the vein, and injure the nerve behind it. M. Velpeau [1] says, "That the cephalic vein is *accompanied on its side* by the external cutaneous nerve, and for some bad reasons states, that nervous accidents are less to be feared in opening this vein than the others; however, further observations will prove that such accidents occur here as well as in the basilic veins, which anatomy easily explains; and it is difficult to believe that M. Lisfranc [2] should affirm that the median cephalic vein is the most advantageous for bleeding, because he never found any nerves near it. M. Gerdy adverts to the danger of wounding the radial nerve in very thin persons, while, on the contrary, M. Velpeau [3] says, "This nerve is separated from the humeral artery by the whole thickness of the brachialis anticus and biceps muscles, and sufficiently distant from all the veins to run no risk of being wounded in venesection." This nerve may certainly be injured in very thin subjects; but in order to effect this, the operator must thrust his lancet into the vein in a most imprudent manner. The median nerve has sometimes been wounded by careless and ignorant phlebotomists, in the same way that the brachial artery, which lies by its side, has been opened. The use of a broad-pointed lancet is the most effectual means of preventing this accident.

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[1] Page 300, tome iii. Anatom. Descript.

[1] See Fig. 108.

[2] See Fig. cit.

[3] Anatomie des Formes, p. 186.

The injury of the cutaneous nerves, which probably often occurs, is not always followed by accidents, if we may judge from the fact of their being rarely observed; such cases, however, do sometimes present themselves, and may cause great pain to the patient, and considerable injury to the reputation of the surgeon, although he ought not, perhaps in the majority of cases, to incur any blame whatever. In a chapter "on the injury of the nerve in bleeding," Mr. C. Bell [4] says, "The convulsive attacks, and the clenching of the jaws *in violence, seem to bear no relation* to the state of inflammation in the wound. They are even greatly aggravated after the healing of the wound." This last assertion is confirmed by three interesting cases which Dr. Valentine Mott has kindly communicated to me, and which he intends publishing. Dr. Mott calls this affection of the arm "traumatic neuralgia:" it appears some time after the simple operation of bleeding, and is explained by a branch of the cutaneous nerve being involved in the cicatrice of the vein, and thus probably pinched or tightened by it. Dr. Mott cured these three patients by a neat removal of the cicatrice. In one instance this talented surgeon traced a twig of the nerve into the excised cicatrice. Several similar examples are also recorded. Scarpa [5] has described many cases in his "minor works" on surgery, to which we will briefly allude, as they are never quoted, although from the pen of so elegant and learned a writer. Scarpa asks the question whether these "terrible neuralgic affections" may not be explained, by the lancet or other body, in wounding the nerve, making an opening in the covering or neurilema through which the pulp of the nerve protrudes, is strangled, inflames, becomes hard, and enlarges! Scarpa quotes, from the authority of Pouteau, the case of a nun who was bled in the foot; a small hard cicatrice followed the puncture of the vein, which was the seat of most acute and constant neuralgia: the pain extended up the leg, thigh, and to other parts of the body. Pouteau made a crucial incision in this cicatrice, but to no effect; the cicatrice having been removed, the patient was instantly cured. Scarpa saw a somewhat similar case in 1811. A peasant woman was pricked in the leg by a thorn, the wound healed quickly, but soon became the seat of excruciating pain, which extended up the thigh and arm; this neuralgia had already existed ten years. Scarpa found a small hard cicatrice in the situation of the puncture, which was acutely painful to the slightest touch; from its situation, he considered the saphena nerve to be the cause of this severe affection; the cicatrice was removed by Professor Jacopi, and upon examination was found to contain a nervous filament, which was compressed and disorganized by this hard cicatrice. The patient was instantly cured. Scarpa was consulted by Signor Mondella for a neuralgia of the arm, which followed venesection: in this case the pain extended to the thumb and fore-finger and to the scapula, and was so intense, that it deprived him of rest by night as well as by day. Scarpa discovered a small, hard and prominent tumor where the lancet had opened the vein; pressure "upon this little tumor produced excruciating pain as rapid as an electric shock." This gentleman objected to having the part removed by the knife; caustic was therefore used, which finally put an end to this most violent neuralgia. According to Scarpa, that estimable surgeon, M. A. Petit of Lyons, cured a young lady of a similar affection, by the application of caustic to the cicatrice. Pott used to mention, says Mr. S. Cooper [1], two cases of distracting pains following bleeding: "he recommended the total division of the nerve, which he supposed was partially divided by the lancet. Dr. Monro relates similar cases in which such treatment proved successful." Mr. Swan [2] relates the case of a lady who for two days was in convulsions produced by acute pain following bleeding at the arm. Dr. Wilson, who attended this patient, made a transverse incision through the part punctured by the lancet, which, not being sufficiently deep, gave no relief; another transverse incision above the first succeeded in dividing the injured nerve, and the patient immediately exclaimed, "I am cured!" Bosquillon, in his notes to Bell's Surgery, mentions two cases of neuralgia of the neck, following bleeding in the jugular veins. I have heard of similar cases occurring after venesection in the saphena vein. Ambroise Paré has given an interesting account of acute pain produced by the lancet, which occurred in the person of King Charles the Ninth of France, who was bled by an expert operator, and "who, thinking to open the vein, pricked the nerve, which quickly made the king cry out, saying, that he felt a very great pain." The arm was immediately contracted, and could not be unbent for three months. Before we leave this subject, and to show how imperfectly it is treated even by the most recent authors[1], we give the following quotation[2]: "The wounds of tendons do not deserve notice, nor even those of nerves; the former can scarcely be wounded in the operation (of bleeding), and would not in all probability, if they were, lead to any bad consequence; the partial division of branches of the cutaneous nerves has given rise to painful feelings in the limb, and to general disturbance of the nervous system. Such occurrences are rare, may be treated by general means, or, if need be, the original wound may be slightly enlarged. No regular dissection of the bend of the arm, as has been proposed, can ever be warranted." Notwithstanding this authority, after the facts we have stated in this paper, the reader will be convinced that the biceps tendon is easily wounded by the lancet, and that the nerves "deserve notice." Mr. Liston himself shows, that enlarging the wound is a very imperfect treatment; and that without making "*a regular dissection of the bend of the arm*," the cicatrice or wound should be removed, or the nerve divided transversely across and above the puncture.

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[1] Anatomie Chirurg., tome ii. p. 419.

[2] See Malgaigne's Op. cit., p. 442, tome ii.

[3] Op. cit., p. 424, 5.

[4] A System of Operative Surgery founded upon the Basis of Anatomy, p. 68. London, 1807.

[5] Opusculi di Chirurgia, vol. iii. p. 18. Pavia, 1832.

[1] Surgical Dictionary, p. 239.

[2] On Morbid local Affections of the Nerves. See also Scarpa and Descot for this case.

If the lancet be plunged too deep, the vein may be pierced through and through, or the blood may escape from both apertures, and thus cause extravasation, which, owing to the superficial cellular fascia, will not be apparent outwardly by any redness of the skin, as in common ecchymosis produced by the blood flowing into the cellular tissue, and when the puncture in the skin is too small, or is not parallel with the incision of the vein. I have lately dissected the arm of a man who was bled a few days before his death, in which there were no outward signs of extravasation of blood; but upon examination, a quantity of blood was found under the superficial cellular fascia, and extended principally along the median basilic vein, to the aponeurotic canal of the communicating vein, where it seemed to pass beneath the aponeurotic fascia as far as the insertion of the biceps tendon into the radius, and surrounded also the deep veins. Careful inspection showed that the median basilic vein had been transpierced by the lancet; coagula were still adherent to the posterior opening of the vessel; the fascia tendinosa of the biceps muscle did not exhibit any corresponding wound; therefore it is highly probable that the venous blood, in flowing out behind the vein, was kept down by the cellular tissue and superficial fascia, and thus found its way to the vena communicans, and hence to the deep veins.

There can be little doubt that the veins of the arm must frequently be transpierced by the lancet, and that more or less blood may pass into the cellular tissue beneath the superficial fascia, and in this manner escape discovery; those pains which are frequently produced by the slightest motion of the elbow after bleeding, may be thus explained. Sometimes also a slight swelling in the neighbourhood of the puncture of the lancet is discernible, and can easily be accounted for by admitting this double division of the vein, which we think will be best avoided by making use of a very sharp and broad-pointed lancet.

The next parts to be described are all covered by the aponeurotic fascia, which cannot be completely understood until the biceps muscle is considered: this membrane however presents many irregularities in different situations; hence it is strongest on the inner side of the bend of the arm, where it generally receives a considerable addition from the biceps tendon; after which it spreads over the pronator and flexor muscles of the fore-arm, and subdivides into distinct sheaths, which confine them in their proper place, and give them support during their contraction. The knowledge of the existence of these sheaths is of great importance, for it explains how matter may be present without forming any tumor, but being kept down by their fascia may extend along the fore-arm; and hence also the necessity of opening them as soon as suppuration appears to have commenced. On the outer side of the biceps tendon, this aponeurosis is reduced to a fine transparent membrane, which, owing to its extreme delicacy, does not seem to cover the tendon; nevertheless it passes over it, and then behind the cephalic vein and musculo-cutaneus externus nerve, where it unites to the fascia given off from the brachialis muscle, which covers the outer or radial eminence.

The muscles which are found in this region of the arm are interesting to the surgeon, and a knowledge of them can alone account for many facts regarding fractures and dislocations. The biceps muscle forms the upper and anterior projection of the bend of the arm; it terminates in a strong tendon, which is somewhat twisted upon itself, and is finally inserted along the posterior edge of the tubercle of the radius, and not, as many anatomists assert, upon that process itself. The fibres of this muscle end very variously in its tendon, which explains the diversity of forms in this part. Sometimes the lower border of the biceps is of a convex form, but more frequently it is more of a triangular one, the middle muscular fibres extending lower down than the lateral ones; the tendon begins higher up the arm on the outer than on the inner side; the outer side of this tendon is always regular in its form and presents a smooth rounded edge. At the inner side, on the contrary, great diversity is observed; thus, sometimes the inner fibres are inserted into the common tendon; at other times they end by a number of small and separate tendons, which are inserted into the aponeurosis of the fore-arm; when this disposition occurs, the tendinous expansion given off by the biceps tendon, is generally slight, or does not even exist; in which case, there is no semilunar fascia, such as is described and delineated by Cowper, Camper, Langenbeck, Tiedemann, Cloquet, Bell, Blandin, Velpeau, Gerdy, Bourgery, Quain, &c. The first good description, and tolerably correct drawing of this tendinous expansion, was given by W. Cowper[1], who called it "fascia tendinosa," and did not restrict its use to the "*more advantageous elevation or bending of the cubit* (fore-arm), *but it also corroborates* (strengthens) *the muscles in those strenuous actions they are necessarily employed in.*" This fascia lies immediately over the brachial artery, and requires careful division when that vessel is to be laid bare. This expansion is united to, and in a great measure forms, the common sheath of the muscles in front of this region; it also principally constitutes the aponeurotic opening for the "vena communicans," which is somewhat enlarged by the action of the biceps muscle, which, by means of the fascia tendinosa, is a "tensor" of the aponeurosis of the fore-arm. This tendinous fascia is generally inserted (or given off) obliquely across the tendon of the biceps muscle towards its outer edge. The biceps tendon, after receiving or giving off this aponeurotic fascia, proceeds downwards through the triangular space left between the inner and outer muscular eminences (pronator and supinator muscles); in this course, it is twisted upon itself, and, like the tendo Achillis, becomes broader before it inserts itself into the posterior border of the tubercle of the radius: many anatomists make this tendon end in the tubercle itself; but this is incorrect. The lower part of this tendon is likewise provided with a bursa mucosa, which enables it to move smoothly over the tubercle of the radius; this synovial sac is formed by a very fine and transparent membrane, covered by cellular and adipose tissue; it extends more than an inch up the tendon and is inserted along its radial side in an oblique and waving line; when blown into, it rises up between the biceps tendon and the lower part of the brachialis anticus muscle; in this state it is in contact with the brachial artery; it also raises up the superior part of the inner side of the supinator R. brevis muscle. It may at first appear singular, why this "bursa" should extend so high up the tendon; it is evident, however, that this lubricating surface is not wanted during flexion of the fore-arm, in which motion the biceps tendon draws the radius directly upwards, and is not in contact with the bony eminence; but, on the contrary, when pronation takes place, then, the biceps tendon presses against the tubercle, and requires the bursa to promote the easy rolling motion of the tendon over that hard surface. This bursa, like all others, may become distended with fluid, and might then present some difficulty of diagnosis, especially if the pulsations of the brachial artery were communicated to it. The biceps tendon becomes prominent during half-flexion of the fore-arm; the fingers may then be almost made to meet underneath it; in certain deformities produced by its violent contraction it might easily be divided by a simple incision, as is done in operating upon the tendo Achillis. In persons whose elbow-joints have been excised, the biceps tendon is extremely prominent; it is, of course, highly important in this operation, to spare, if possible, the insertion of this tendon, which is so valuable in all manual labour, and by whose assistance patients thus operated upon have been able to lift heavy weights, and pursue various avocations, &c.

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[1] Mons. Mondière, Archives de Méd., p. 300, 1837, in his analysis of Mr. Swan's work, very justly remarks, that this subject is not even mentioned in the new Dict. de Méd., and, I might add, many other French productions.

[2] Page 192 of Mr. Liston's Practical Surgery. London, 1837.

For the better comprehension of the muscular parts of this region, we proceed at once to the description of the brachial muscle, leaving the vessels which lie upon it to a future period, on account of these two muscles acting together in various ways and producing very similar effects.

The brachialis anticus (*brachiæus internus, humero-cubitalis*) is a strong muscle which fills up the hollow left between the two condyles of the arm-bone, and partly covers the condyles themselves; the lower extremity of this muscle is of an irregular shape, adapted to its situation, which is uneven. Its outer side is the strongest where a thick tendinous band lies upon the side of the head of the radius; the back or deepest part of this muscle is pretty closely attached to the capsular ligament of the joint, as well as to the coronoid process of the ulna, by means of small tendinous fibres; hence, probably, the very common error of describing "the brachialis tendon as inserted into the coronoid process of the ulna," (Sir A. Cooper, B. Cooper, Jones Quain,) whereas, this tendon is finally inserted into an oblique line below that process, and across the front part of the cubitus, exactly opposite the tubercle of the radius. This muscle generally sends off an aponeurotic expansion which spreads itself over the supinator longus, and thus strengthens the common sheath of the fore-arm; there are sometimes some tendinous fibres which unite themselves to the tendon of the biceps muscle.

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[1] Myotomia Reformata, p. 74.

The brachialis muscle, by filling up the hollowed surfaces between the condyles of the arm-bone, gives a more regular form to this region; nevertheless, the inner half of the lower end of the humerus, which extends lower down than the outside one, presents also a more prominent surface, called trochlea; this projecting surface being covered by the brachial muscle and pronator radii teres muscle, constitutes in a great measure the inner eminence of the arm which has been incorrectly attributed to the flexor muscles of the fore-arm, which scarcely contribute to its size, owing to their superior origins being comparatively small, pointed, and tendinous; this projection is much larger in the male than in the female, on account of the greater muscular and osseous development. When the biceps and brachialis muscles act together, the fore-arm is bent upon the arm, and each giving aponeurotic fibres to the common sheath of the limb, must alike be considered tensors of the aponeurosis. When the biceps contracts slightly, its tendon becomes more prominent, the furrow at the bend of the arm disappears; the brachialis muscle being intimately attached to the capsular ligament does not rise forward like the biceps tendon, and hence it produces but little visible change in the form of this region, when put into action. In fractures and dislocations, these two muscles may perform various offices; if the neck of the radius be broken, the biceps will displace the lower fragment of the fractured bone and thus prevent its union; if, on the contrary, as is commonly the case, the radius be fractured below the tubercle of the radius, the biceps by its contraction may draw the upper fragment of bone forward; thus, it is quite wrong to lay down as a general rule, that in fractures of the superior third of the radius the biceps draws the upper fragment forwards. The brachialis muscle may act in a very similar way as regards fractures of the ulna and its coronoid process; if the coronoid projection be alone broken off, this muscle, being inserted below it, may keep it down and prevent any displacement occurring; and also render the diagnosis somewhat difficult; may not this be the cause of such fractures escaping detection? If the coronoid process be fractured with a small portion of the upper part of the ulna, situated below the insertion of the brachialis tendon, then, this muscle will pull up the superior extremity, while the triceps will tend to draw the olecranon upwards and backwards, and thus produce dislocation of the humerus forwards, or the ulna alone, backwards, which is most commonly the case. From not attending to the exact situation of the insertion of the brachialis tendon, a common mistake has likewise arisen, that when "the coronoid process of the ulna is broken off, there is nothing to counteract the action of the triceps muscle, and the ulna must be drawn backwards and upwards;" this will evidently occur when the coronoid process is separated from the ulna below the insertion of the brachialis muscle.

In luxations of the radius backwards upon the external condyle, or upon the side of the olecranon, which I believe is the more common case, the biceps, by contracting, may considerably increase the displacement and cause the head of the radius to press against the skin, where it is almost destitute of adipose tissue, and may easily produce its mortification. The action of the biceps muscle will also tend to increase the displacement of the head of the radius in its luxations forwards upon the pulley-like surface of the humerus, and probably in part prevents dislocation of the radius upon the coronoid process taking place, owing to its contraction drawing the bone immediately upwards; besides, the thick end of the brachial muscle also prevents the head of the radius from lying upon this part of the ulna; nevertheless, some surgeons seem to think that this sort of dislocation is frequently met with. I have examined several specimens of luxations of this bone, but have not yet seen this sort of displacement. In luxations of the humerus forwards it is principally the brachial and biceps muscles which limit its displacement, and offer an impediment to the extremity of the bone passing down the fore-arm, or through the integuments; in this action, these muscles may be opposed by the violent contractions of the triceps, which by pulling up the cubitus will increase the displacement of the humerus; hence in these dislocations, the biceps tendon and brachial muscle are put upon the stretch, especially the latter (a few fibres of which are probably always lacerated), as may be seen by referring to a drawing (plate 24) of it in Sir A. Cooper's work on dislocations. Sometimes, however, the violence of these injuries is so great that the muscles no longer bar the progress of the humerus; they are torn through; the bone still advances, tears through vessels and nerves, and finally protrudes through the integuments. The annals of surgery record several such cases, and M. Cruveilhier has lately published (p. 8, Fasciculus ix. of his Anat. Patholog.) a similar observation of an English lady who, falling from her horse, on the palm of her hand, sustained a compound luxation of the lower end of the humerus forwards; the end of the bone protruded; the brachial artery and veins were ruptured, which caused violent hæmorrhage and syncope; nevertheless, the bone was reduced and the patient recovered. It is almost needless to observe how very important it is, in excision of the elbow-joint, to avoid if possible cutting away the insertion of this muscle.

The brachial muscle, which is closely connected to the capsular ligament by means of small tendinous fibres, may be partly considered as a ligament to the joint, which perhaps also explains the reason why the anterior part of this articulation should be apparently so weak.

Between the biceps and brachial muscles there is mostly a quantity of cellular and adipose tissue which surrounds the artery, veins, and median nerve; this substance sometimes becomes inflamed, giving rise to deep-seated abscess, which requires peculiar caution in opening, on account of the number of vessels in its vicinity. The brachial artery lies upon the inner and anterior surface of the brachialis anticus muscle, on the outer side of the median nerve, which at the bend of the arm is not very close to it, owing to that nerve passing more inwardly to dive under the pronator radii teres muscle. The artery passes downwards towards the radius along the triangular space found between the outer and inner muscular eminences, and on the inside of the tendon of the biceps muscle; when about two inches below the tuberosity of the inner condyle of the humerus it divides into the radial, ulnar, and interosseous arteries, which will be described elsewhere. This artery is accompanied by two veins called the satellite veins, or venæ comites, or deep humeral veins; one of these vessels generally passes over the front of the artery near the middle of the bend of the arm. This artery is first partly covered by the inner border of the biceps muscle, a little lower down by its tendon, and "fascia tendinosa;" by branches of the internal musculo-cutaneous nerve; by the median basilic vein; by lymphatic vessels; by the superficial cellular fascia; by a layer of adipose substance; and, lastly, by the integuments; of these different parts the most important in a practical point, are the basilic vein and biceps tendon. The humeral artery is generally described as being crossed by the basilic vein at the middle of the bend of the arm; therefore, M. Gerdy, like many other writers, says, there is much less danger of wounding the artery when bleeding that vein, above and below, than in the middle point; frequently, however, the artery takes exactly the same course as the vein; but even then, there is in fact more danger of wounding the artery in this middle part, on account of its passing over the most prominent point of the brachialis muscle, causing it to be more superficial, and less likely to escape injury, that muscle presenting a resisting surface; whereas, if venesection be performed lower down in the same vein, there is much less risk of puncturing the artery, because it lies deeper, and is also more protected by the biceps tendon and fascia; nevertheless, it is always imprudent for the surgeon to open the vein in the course of the artery, a subject which we must touch upon presently, as it presents much interest. This artery can always be felt pulsating at the bend of the arm; the operator should always examine this region very carefully before bleeding or cutting down upon the artery, on account of the frequent irregularities which that vessel presents; surgeons have often been much puzzled at meeting with these anomalies, during their operations, of tying the brachial artery, but in many cases a minute inspection of the limb might have previously put them on their guard.

For a knowledge of these varieties of the artery, the reader must refer to the works of Meckel, Harrison, Tiedeman, and my friend P. H. Green's interesting little book "On the Varieties of Arteries." All anatomical museums contain preparations of such cases; several are mentioned in Dr. Hodgkin's excellent catalogue (sect. iii.) which is a most praiseworthy example to all professors of anatomical collections, which at present are of very limited utility, owing to their being so little known to the profession at large; we hope to see the former taste of giving splendid representations of interesting preparations which are concealed in cupboards, revived; the labours of Ruysch, Sandifort, and Fred. Meckel, show that the subject is not unworthy of great minds.

Notwithstanding the great diffusion of anatomical knowledge, this artery[1] is still sometimes injured in "bleeding" at the arm by ignorant or incautious operators; the result of this wound is almost always an aneurism, of that kind called "false diffused, false circumscribed," or both these together; or of that kind termed varicose aneurism, which may also be accompanied by one or both of the two former. As this is a point of great practical importance, and as we possess an observation of this disease, which is badly understood, we cannot refrain from publishing it, hoping it may throw some light upon an obscure affection, and elicit further observations.

This species of aneurism was first clearly pointed out by Dr. William Hunter (in 1757 and 1762). This celebrated man was too modest to attach much importance to the name of this disease,—"whether it should be called an aneurism or a varix, or both or neither." It would appear[2], however, that he named it, "*aneurism by anastomosis, being caused by an anastomosis or communication of the vein and artery.*" George Cleghorn, professor of anatomy in Dublin, was the next person who distinguished this sort of aneurism. In a letter to W. Hunter, Cleghorn gave a very good account of a case which occurred after bleeding, in the arm of a boy aged seventeen. Cleghorn proposed calling this disease aneurismal varix. In describing the symptoms of this affection, he lays great stress upon the thrilling sensation and hissing noise which are perceived by placing the ear upon these aneurisms, or by applying one end of an iron rod, or catheter, to the tumour, and the other to the ear; this is probably the first time "mediate auscultation" was ever used to facilitate the diagnosis of aneurisms. Cleghorn likewise enriched his letter with an engraving which portrays the dilated state of the basilic, cephalic, and median veins [1].

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[1] Formerly this accident was of very frequent occurrence. Dionis tells us, that "a celebrated surgeon, whose name is much respected among us, and who was most skilful, and had acquired greater fame *for bleeding* than was ever possessed by any other phlebotomist, confesses to have opened the brachial artery eleven times in the course of one year (before 1716); a misfortune which he could not avoid, says Dionis, because he was called to so many difficult cases."—Huitième Démonstration Anat. p. 593, 4.

[2] See S. Cooper's Surg. Dict.

These valuable observations had not probably reached foreign shores, when Guattani, of Rome, published a good memoir upon aneurisms, in which he describes this new species; hence, some persons, totally ignorant of dates, have endeavoured to rob British surgery of one of its numerous glories; however, Guattani [2] saw his first patient in 1769, and his second in 1771. He published his paper in 1772; it is, therefore, surprising that the learned Monteggia [3] should have written, "*that this disease was first described by Guattani, then by W. Hunter, to whom improperly is attributed the discovery.*" As a corroboration of this statement, Monteggia refers to Arnaud's Mémoires, where the reader may search in vain even for Guattani's name. Scarpa, on the ground that Guattani was ignorant of Hunter's papers, is anxious to claim an equal share of merit for his countrymen, which impartial history will not grant.

Of all the forms of aneurism, this one is doubtless the least understood. Opportunities of investigating the morbid condition of the parts affected rarely occur: few authors, therefore, have been enabled to give a tolerably correct history of this affection. The majority of surgeons prefer leaving the disease to nature, or, when they do interfere, operations are performed which not only disturb the relative situations of parts, but likewise destroy their integrity: hence, should the patients eventually sink under the operation, very little can be learnt by anatomical inspection: for these reasons, therefore, we must not be surprised that many opinions concerning this disease should be founded on erroneous or conjectural grounds. To save time, we shall at once draw the following conclusions, from the most approved and recent authorities, which will show at a glance the state of science upon this subject.

Varicose, or arterio-venous aneurism generally occurs after bleeding at the arm, and is caused by the lancet running through both sides of the median basilic vein, into the brachial artery which lies beneath it; the external wound of the integuments and vein heals up, while the puncture through the opposite side of the vein remains open, and receives more or less blood from the injured artery. These are considered the necessary conditions of this sort of aneurism; and the consequence is, that the superficial veins of the arm become "varicose, aneurismal, and pulsate." These views, which were first established by W. Hunter, have been followed by Scarpa, Hodgson, Delpech, Roux, Dupuytren, Bell, Wardrop, Breschet, Liston, &c. This sort of aneurism has likewise been detected in other parts besides the arm, as the axillary, subclavian, carotid, femoral, and popliteal vessels; nevertheless the same explanation has been given; the veins have always been supposed to have been divided through and through. These additional examples prove that varicose aneurism may exist between deep as well as superficial veins and their corresponding arteries. It must notwithstanding be recollected, that all the cases of varicose aneurism produced by bleeding at the arm, have invariably been represented as existing between the superficial median basilic vein and the brachial artery. I know but one exception, namely:—Park's case of aneurism, mentioned in J. Bell's work, which could not be explained by that author, and was consequently considered, and called, "an anomalous case of aneurism."

The object of these observations, is to demonstrate, that varicose aneurism and aneurismal varix may be produced by the lancet injuring the deep veins and brachial artery. We have been fortunate in having an opportunity of dissecting a limb affected with this peculiar form of aneurism; and from the case being ripe with interest, it appears a duty to communicate the principal facts connected with it. The case is such as seldom finds its way into print, unless when persons are actuated by the lowest motives; and I beg the reader will reflect, that I am indebted, for the dissection of this limb, to M. Roux, whose friendship I prize as much as I admire his scientific and high-minded character.

The patient was a female about thirty-five years of age, of delicate form; during an illness she was bled in the arm by a female friend; the artery was opened; a tumor or circumscribed false aneurism, with all the symptoms of varicose aneurism, was the consequence. M. Roux saw the patient soon after this accident, and decided upon giving J. Hunter's operation a trial, for the cure of this double form of aneurism. The brachial artery was therefore tied at about the middle of the arm. The tumor, or circumscribed false aneurism, disappeared after this operation; the varicose aneurism, however, still continued; and the patient left the Hospital of "La Charité." The disease made slow but gradual progress. This unfortunate female now applied to MM. Dupuytren and Lisfranc for relief; but these gentlemen preferred "*doing nothing*." The pain in the arm, the increasing weakness of the limb, with its gradual emaciation, and its distressing whizzing noise, at last drove the patient to the resolve of having something done; she returned once more to M. Roux, full of courage, and determined to submit to any operation which presented the slightest hopes of alleviating her sufferings. She was admitted into "La Charité" in 1834, which was about three years after the trial of the Hunterian operation. I saw this patient but once, and on the day of the operation; the arm was very painful, and much smaller than the healthy one; the superficial veins (cephalic and basilic) at the bend of the arm were very large and varicose, and pulsated as far as the middle of the upper arm; these pulsations were visible to the eye; the peculiar whizzing noise and thrilling sensation were extremely well marked. At the middle of the upper arm a long cicatrice existed, where the artery was formerly taken up; at one point of this cicatrice the pulsation of the vessel entirely ceased; several smaller cicatrices, evidently the result of repeated venesection, were discernible at the bend of the arm, a circumstance of some importance, as their existence (together with a tumor formerly in the same point, which must have produced some disturbance in the exact relative situations of these parts), must make it difficult to point out the precise spot where the artery had been punctured. M. Roux now determined upon cutting down to the brachial artery at the bend of the arm, and applying a ligature upon it both above and below the point where this vessel communicated with the vein which was supposed to be the "median basilic." I assisted M. Roux in this terrible and perplexing operation. He endeavoured to put a ligature round the artery, first, immediately below its wound. In proceeding towards this step, a large superficial vein was cut (probably the median basilic), which poured forth its blood in great profusion: compressing the artery did not entirely arrest it: the quantity of blood gushing out of this vein at each pulsation of the artery determined M. Roux to pass a ligature round it by means of a curved needle, taking all precautions to avoid any other surrounding parts, &c. M. Roux again proceeded towards the artery, but every incision of the scalpel was followed by a fresh hæmorrhage; the patient complained of acute pain, and the wound was constantly filled with blood; for these reasons the operator abandoned the idea of laying the artery bare, and, feeling for it with his finger, he was soon satisfied that he could distinguish its pulsation: he then plunged a curved needle and ligature immediately beneath his fingers, and tied the artery tight: from this mode of proceeding, other parts besides the artery were necessarily exposed to being included in the ligature. The operator believing that the lower extremity of the artery immediately below its communication with the vein was now secured, fancied this single ligature might suffice; this was in fact reasoning on the Brasdorian principle. M. Roux appealed to me. I put my fingers upon the brachial veins, which pulsated with their wonted force: the idea, therefore, of leaving the patient in this state was immediately rejected. M. Roux now proceeded to take up the artery above its point of union with the vein, the exact situation of which was very difficult to ascertain. Scarcely had the knife been again resorted to, but another large pulsating vein was wounded, which caused profuse bleeding, and was secured by the needle and thread, as before. The dread of further bleeding from the use of the scalpel (which was perhaps too freely used in this perilous operation), prompted the operator to employ it no longer; he therefore again resorted to the curved needle and thread, by which he finally embraced the artery: the tightening of these ligatures produced considerable pain. It was now fully believed that the artery was tied both above and below its wound; nevertheless the pulsations at the bottom of the incision and in the veins were still very strong. In this perplexing state of things, which could not be accounted for, the surgeon's ingenuity and knowledge were completely at a stand; in despair of further benefit, he brought the lips of the incision together, having previously filled up the bottom of the wound with some charpie (French lint), and the patient, extremely exhausted from pain and loss of blood, was conveyed to her bed. Several hæmorrhages occurred the following days; the arm was still very painful; the veins pulsated forcibly; and the dread of fatal hæmorrhage led M. Roux to amputate the upper arm at about its middle. The unfortunate sufferer survived this operation only a few days. M. Roux kindly gave me the amputated limb to dissect, but owing to the various wounds made in the superficial veins, and also to the destruction of parts by suppuration, it was impossible to give a correct view of the more superficial organs; we took a sketch of the deeper parts, which we hope will be sufficient to explain the peculiarity and the extreme difficulty of this case, and also be a warning to surgeons in future how they undertake an operation so hazardous for the patient, and so perplexing for the operator.

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[1] John Bell's introduction of the terms "aneurism by anastomosis" to denote "nævus maternus;" and the distinction which some writers draw between aneurismal varix and varicose aneurism, have already created some confusion in this point of nomenclature. To avoid all ambiguity, MM. Dupuytren and Breschet prefer the name of arterio-venous aneurism, or aneurism by transfusion; we shall employ the word "varicose," which is generally understood, and means, properly, an aneurism formed by the communication of the artery and vein; the "aneurismal varix" is a distended state of the veins which pulsate like arteries, and is the consequence or extension of the varicose aneurism which frequently exists alone.

[2] De Spurio Brachii Aneurysmate, p. 223, 224. See Louth's collection of Theses.

[3] Instituzioni Chirurgiche, p. 183. c. i. Milano, 1829.

By casting a glance over the sketch, the following particularities will be observed.

This was a perfect example of varicose or arterio-venous aneurism, and aneurismal varix, exactly similar, in outward appearances and symptoms, to the disease first pointed out by William Hunter, and first delineated by Cleghorn: it was likewise considered such by all the surgeons who saw it. It differed, however, in this respect, that the communication did not exist between the median basilic vein, or superficial vein, and the artery, as all authors affirm, but between the brachial artery and one of its accompanying satellite or deep-seated veins, resembling those cases of varicose

Fig. 109.

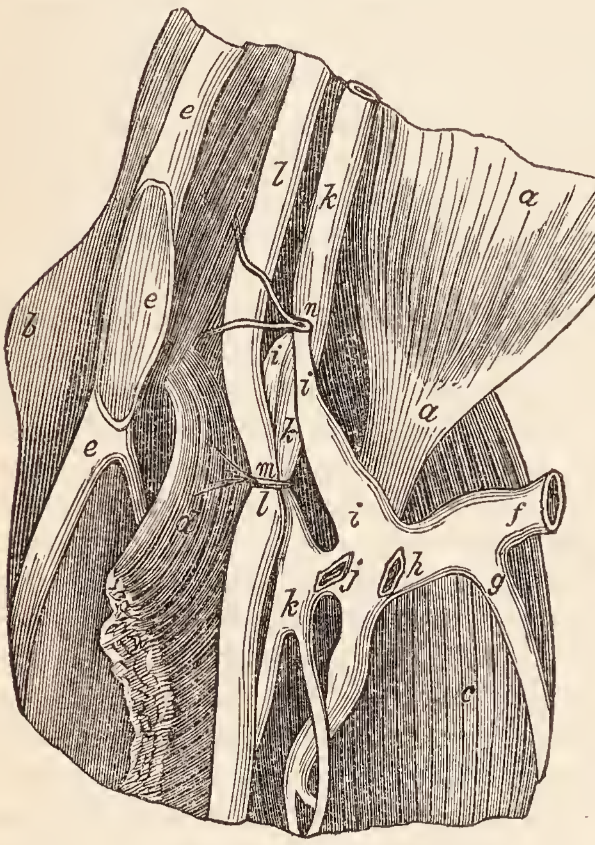

Fig. 109 *represents the front and deep region of the elbow of the left arm.* a a, *The biceps muscle and its tendon, both placed sideways.* b, *The tuberosity of the inner condyle of the os humeri.* c, *The supinator R. longus muscle.* d, *The pronator radii teres divided, and thrown aside, to allow of the vessels being seen.* e e e, *The basilic vein partly cut away, where probably the median basilic vein joined it.* f, *Probably the median cephalic.* g, *The radial vein.* h, *The "communicating vein" much enlarged and springing from an enormous satellite vein,* i; *this "vena communicans" is in a direct line with the canal which existed between the brachial artery, and its deep accompanying vein;* j, *marks the point, where this canal has been laid open to show it more fully. Close to the letter* h *is another aperture, where, probably, some enlarged vein was cut away. This sketch shows most distinctly that the superficial veins of the arm became varicose, and aneurismal, by means of the "vena communicans."* i i, *The satellite veins (venæ comites), which decreased as they became more distant from the wound in the brachial artery; they have been removed at the point where the ligature* (n) *surrounded them, not presenting any remarkable feature.* j, *At this canal, between the artery and deep-seated vein, it was impossible to say where the artery began or ended; it was like a perfectly new vessel, existing naturally between the vein and artery.* k k k, *The brachial artery with its lower division into radial and ulnar arteries which were extremely small, thin, and more like veins.* l l, *The median nerve which was tied with the artery* (*at* m) *at the first step of the operation.* n, *The second ligature which traversed the artery, merely taking in about two-thirds of its circumference.*

aneurism which are sometimes seen between the femoral, carotid, and axillary arteries and their corresponding veins, &c. several examples of which are already recorded in the annals of surgery. It is probable that the lancet passed through the median basilic vein, then through the satellite vein, and finally into the artery, making thus no less than five openings in these vessels; viz. two in the median basilic, two in the satellite veins, and one in the artery, which may also have been pierced through and through; making in that case six apertures in those vessels. The superficial veins, principally the basilic and cephalic, were extremely varicose, apparently owing to the free anastomosis established between them and the deep-seated veins, by that important trunk the "vena communicans." By the assistance of this vein, the blood propelled by the artery into the satellite vein would find less difficulty in passing directly into the superficial veins, which are larger, and perhaps more easily dilated than the deep-seated veins, than it would experience in distending the venæ comites, or satellite veins, which are considerably smaller. This observation also proves that the artery becomes dilated above the injury, and diminishes in size below it, where its trunk, as well as its branches, partake more of the appearance of veins than of arteries; a fact which is given as a novelty by M. Breschet, but which is distinctly mentioned in several places by his predecessor, P. Adelmann, to whose interesting memoir we shall presently refer. This diminution of the artery below the wound is easily accounted for, by that general law which holds in pathology, that when an organ no longer fulfils its natural function, it diminishes in size, or wastes away: here, the arteries below the wound receive very little blood, and therefore have scarcely any labour to perform, while, on the contrary, the veins having much more to do, increase in size and thickness, and appear *arterialised.* The blood which ought to pass on to the extremity of the limb stops half way, and returns by the new and unnatural canal between the artery and the vein, which is a sufficient explanation, according to Delpech, of the wasting away of the fore-arm. This dissection likewise shows:—1. How difficult it is to point out the exact spot where the lancet had pricked the artery; and therefore the proposal of cutting down to that point, and applying a ligature upon the new canal, is not, as is stated, a very easy and simple proceeding:—2. That surgeons may easily be deceived with regard to the precise point where injury has been inflicted on the artery by the lancet, owing to the basilic vein lying over, and nearly corresponding to the situation of the artery and its accompanying veins. It may perhaps, in future, be possible to distinguish when the anastomosis exists between the artery and deep veins, and when between the artery and the superficial veins, by paying particular attention to the exact spot of the greatest intensity of the thrilling sensation and whizzing noise, which will probably appear to come from a lower part than where the cicatrix at the bend of the arm is seen; and also the dilatation of the superficial veins will be the greatest at the point where the "vena communicans" joins the superficial and deep veins together, which is much lower down the fore-arm than where bleeding is performed:—3. That the Brasdorian operation of tying the artery on the distal side of the aneurism would have no chance of success in an old case of varicose aneurism, owing to the free passage of blood through this new and perfect anastomosis :—4. That tying the artery, upon J. Hunter's principle, is decidedly injudicious, and not in accordance with that great man's views, who was induced to tie the vessel at some distance from the disease, lest it should not be in a sound state : in this form of aneurism such fear is almost groundless. This case, with many more mentioned in M. Breschet's interesting paper, proves beyond refutation, that little benefit can be obtained by tying the brachial artery at the middle of the arm. This observation likewise shows, that a ligature placed above and very near the disease may sometimes be ineffectual, especially in an old case, and in which the artery was formerly tied at a distance from the disease; both these causes rendering the collateral circulation in the anastomosing vessels very active. Finally, the result of this operation warns the surgeon of the danger of using the needle and ligature in the dark, or at hazard; since the median nerve was comprised in one ligature, and the brachial artery transfixed by the other.

I cannot finish this important subject without making a few more observations. After having clearly made out this disease by careful dissection, I was naturally astonished that similar cases should not have been described, and felt convinced that they must have existed. I have since that period discovered that two observations of varicose aneurism (between the artery and deep vein) of the arm are upon record, but they have not been duly understood or appreciated. In speaking of varicose aneurism of the arm following bleeding, Mr. Liston[1] makes the following extraordinary assertions : "*But aneurism may form in communication with the vein, and* TWO *cases of this kind are recorded. This is, properly, varicose aneurism, a disease oftener talked about than understood. This form is treated in the same way as the false aneurism in its early or more advanced stages, by ligature at the wounded part, or in the middle of the upper arm.*" It is hard to imagine how this author can only have cognizance of two cases of this kind of aneurism ; his reading must indeed be very limited. But what is most surprising is, that Mr. Liston should have added a wood-cut engraving (without explanations) for the better comprehension of a disease so little understood. This drawing is meant to represent a pure case of varicose aneurism, and is evidently copied from J. Bell's work on Surgery, for there is only this slight difference : Mr. Liston has represented all the fingers extended; while in the *original*, two fingers are partly closed. Now this drawing, which represents, according to Mr. Liston, a common example of varicose aneurism, is considered by Bell "*an anomalous case of aneurism*" (Principles of Surgery, vol. i. p. 302.), which he could not rightly understand, and which was from the practice of Park of Liverpool. Messrs. J. and C. Bell both consider varicose aneurism, after bleeding at the arm, to exist between the superficial vein and artery ; they however conceive that the lancet may wound the deeper veins. "*These 'venæ comites' also are sometimes struck with the lancet, and then the artery and veins are all* MASSED *together. Perhaps the anomalous case related by Mr. Park of Liverpool was of this nature.*" It is really singular that Park, Bell, and Mr. Liston have not remarked that their engraving represents most distinctly a canal or communication between the brachial artery and one of the satellite veins, which last seems to dilate into an aneurismal sac, and might have been probably the "vena communicans" distended. The drawing proves beyond a doubt, that there was nothing anomalous in this case; it was purely an example of varicose aneurism and aneurismal varix, similar to the one we have been describing. Mr. Liston could not have chosen a worse specimen of drawing for his object ; indeed, it is utterly impossible for the student to understand the sketch without any reference, the more especially as Bell and Park could not clearly make out this case, and hence they called it *anomalous ;* notwithstanding this, Mr. Liston produces the engraving to illustrate the principal features of a common varicose aneurism of the arm. Although we entertain no doubt that Park's case can be perfectly explained according to the views we have endeavoured to establish, still, as scepticism is a prevailing rule with many readers, I am happy in being able to present another confirmation of most of the explanations now offered. In a recent tour through Germany, I met with a preparation of varicose aneurism (in the small anatomical museum at Würsburg, formed principally by the labours of Hesselback and the Siebolds), which will throw much light upon the present subject. This preparation was made in 1818, by Dr. Hesselback junior : a brief, clear, and good history of this interesting case is found in P. Adelmann's Tractatus Anat. Chir. de Aneurysmate spurio varicoso. Würceburgi, 1821, a work mentioned by Mr. Samuel Cooper, in his bibliographical references at the end of his article Aneurism (See Dictionary of Prac. Surg.) ; but this erudite author has given it a wrong date, and does not appear to have read it, otherwise he would certainly have been struck with its remarkable contents. This modest production is so little known, that we shall give an outline of the case. This varicose aneurism (and aneurismal varix) existed in the right arm of "Laurentius Drescher," and was caused by the explosion of a gun which was charged with shot : the patient lived twenty years with this aneurism, which was never operated upon. Adelmann has given an engraving of the preparation, which shows that the communication existed merely between the brachial artery and the satellite vein : the median basilic vein became dilated and aneurismal in this case, as in our own, by the ready communication of the deep with the superficial veins of the arm, by the important branch, " the *vena communicans.*" This is not our own inference. Adelmann tells us distinctly, " Ibi loci vena mediana pulsu vehemente sanguinis arteriosi ex vena brachiali (the satellite vein) per dictum ramum conjungentem in se irruentis, sacci ad instar est dilatata." We thus possess three cases of varicose aneurism of the arm, existing between the deep veins and brachial artery, and twice caused by the lancet. The cause of the disease is of little consequence ; whether it be produced by the lancet, or by shot, the result is almost alike, the symptoms are nearly similar, and the disease equally inconvenient or dangerous. Are we not now justified in hazarding the opinion, that it is extremely probable that many of the cases which have been considered aneurisms of the superficial vein and artery of the arm, have in reality occurred between the artery and the deep veins ? In fact, it appears to us almost impossible for any sharp instrument to open the brachial artery, without injuring at the same time the veins which cover that vessel, more or less ; and in this case, why should not the blood of the artery flow more easily into the adjoining vein than into a vein situated at a greater distance ? We trust that future cases of varicose aneurism will be more carefully examined, as this is the only way of settling these interesting points of surgical pathology.

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[1] See Practical Surgery, p. 177. 1838.

We must now add a few words concerning the best operation for the cure of this kind of aneurism. Surgeons entertain very different opinions upon this important matter : some consider all operations unnecessary ; the disease, they argue, does not endanger life ; it is merely an inconvenience : others, on the contrary, " treat this kind of aneurism in the same way as the false aneurism in its early or more advanced stages, by ligature at the wounded part, or in the middle of the upper arm." (See Liston, Op. cit.) M. Breschet has taken great pains to show that tying the brachial artery, according to Hunter's plan, is both dangerous and insufficient : he has brought forward a good many instances of such operations performed by Dupuytren having failed ; for this reason, M. Breschet is a partisan of the old operation of cutting down to the artery (or sac), and tying it both above and below the part wounded. I entirely agree with M. Breschet in banishing Hunter's operation from the treatment of this disease ; but cutting down to the wounded artery, and passing two ligatures around it, requires some consideration. There is an essential difference in operating upon a recent or upon an old varicose aneurism : in the one, the operation may be easy of execution, and happy in its termination ; in the other, it may be most laborious in its performance, and most fatal in its results ; we even doubt whether the same operation is applicable to both cases. We shall venture a few, perhaps, premature opinions regarding the best operation for this kind of aneurism, in hopes of soliciting further observations from more experienced pens. In recent cases of varicose aneurism, we believe, a cure may be effected by simply applying one ligature above, *but close to the injured* part of the brachial artery. I was requested by M. Carron du Villards to see a patient (a woman, ætat. 55), who had been bled by a young student : the artery was opened, and all the symptoms of varicose aneurism existed. I strongly recommended cutting down to the artery close to the small tumour, and securing it with a thin silk ligature. We performed this operation about a fortnight after the accident. The incision was made above and almost upon the small tumour : the operation was very easy ; it gave rise to no bleeding or injury to the veins, and the patient was rapidly cured. M. Breschet objects to tying the artery close to the disease, lest inflammation of the vessel cause the ligature to cut through the artery too soon ; but this appears rather a groundless fear. My friend, Prof. Lallemand, of Montpellier, likewise now pursues this plan of operating for varicose aneurism : he has favoured me with the history of a successful operation performed (in 1836) upon the right-arm of a man, aged 34, who had been bled in the median basilic vein, which caused a varicose aneurism. In old cases we should hardly expect a cure from simply tying the artery immediately above the point of injury : in these cases, if an operation is resorted to, it would be best to make a very careful and prudent dissection of the artery, using the knife as little as possible, and to tie it above and below its wound.

Before we describe the muscles of the posterior side of this region, we must briefly speak of other parts which partly cover them : we have elsewhere observed that very little fat exists over the olecranon and surrounding points of this region, which is supplied on the other hand with fibro-cellular tissue, and also with a subcutaneous bursa mucosa. The cellular tissue is stronger, more fibrous or elastic, opposite the olecranon and inner tuberosity of the humerus, to which it connects the skin, as we have already noticed, than in the other situations or depressions of this surface. When the cellular substance is more delicate, it contains a very slight quantity of adipose tissue, is easily inflated with fluid ; which accounts for the elbow swelling with such facility in cases of hæmorrhage following divers injuries. This cellular tissue greatly contributes to the free motion of the skin over the olecranon and other bony projections ; under this cellular substance, and upon the most prominent part of the olecranon we find the bursa mucosa, which ought to be inflated, to be well studied ; it is generally of a globular form, about the shape and size of the human eye-ball, surrounded by cellular tissue, which forms a sort of sheath for it, but from which it can be entirely separated by careful dissection. I have mostly found it constitute a single sac, but quite independent of the neighbouring tissues.

M. Velpeau, on the contrary, seems to consider it more as an accidental formation ; "over the olecranon the cellular tissue is condensed in such a manner that it often gives rise *to a real bursa mucosa, of variable capacity, and contains but little fluid* in its healthy state, but is easily filled upon the slightest injury[1]." M. A. Berard[2] says, he has seen this bursa contain several cavities ; from repeated dissections, I am induced to believe that this bursa always exists in the natural or healthy state of the limb. Beclard[3], who perhaps took undue credit to himself as regards the description of the bursæ mucosæ, remarks that this sac is found before birth, and can easily be seen on account of a sufficient quantity of fluid which lubricates its interior." This bursa, like that of the patella, is sometimes distended with fluid of various natures, which has been described under the name of hygroma. Some surgeons have proposed injecting this cavity with stimulating fluids, as in hydrocele : when this operation is performed, great care must be taken to avoid injecting the cellular tissue around the bursa, which would cause considerable inflammation. This bursa is constantly exposed to blows, yet it is but seldom found diseased. In fractures of the olecranon it must generally be more or less injured, on account of its being so intimately attached to that bone.

The principal muscles worthy the surgeon's attention in this posterior region are the following :—The triceps muscle, which at its lower end is provided with a strong tendinous-like fascia, fills up the hollow surface situate between the two condyles of the humerus ; and, when the limb is extended, almost prevents the olecranon from projecting, owing to its thickness rising nearly to its level ; when the fore-arm is bent, it is this muscle which forms the flat surface of the elbow immediately above the olecranon. The greater part of the outside of this muscle is formed by a broad tendinous-like fascia which is very similar to that of the rectus of the thigh. This broad tendon sends off an aponeurotic fascia which inserts itself along the external and posterior edge of the ulna, covers the anconeus muscle (which partly arises from it), and also inserts itself into the external condyle of the humerus, and unites to the tendinous origins of the muscles which spring from that eminence. This fascia does not spread over the back part of the ulna, which is merely covered by its periosteum, bursa mucosa, and cellulo-fibrous tissue. The thickest part of the triceps muscle is found exactly in its middle, and is inserted into the olecranon. The outer fibres of this muscle are inserted into the back and upper part of the external side of the cubitus along side of the anconeus muscle ; the tendon of the triceps does not extend so far inwardly as it does on the opposite side : there is generally a fleshy portion of this muscle lying close to the cubital nerve.

M. Velpeau, who justly remarks that the tendon of the triceps is not inserted into the most prominent part of the olecranon, but rather towards the articulating surface of the joint, says, that this disposition favours the formation of a synovial membrane which he has sometimes discovered. I have never yet met with this occurrence. The front of this muscle, which lies immediately upon the capsular ligament of the elbow-joint, to which it is likewise connected by means of a number of cellular fibres, may probably draw up the ligament during its contraction. This powerful muscle extends the fore-arm, and is likewise a "tensor of the aponeurosis which binds down the anconeus muscle and prevents its being seen during its contraction.

The anconeus muscle which some anatomists consider merely as a portion of the triceps muscle, on account of its course, use, insertion, and the frequent difficulty of separating the one from the other, is of a triangular shape, flat, and fills up the hollow surface on the outside of the olecranon, and the space between that process and the head of the radius. Its superior fibres arise fleshy from the upper part of the outer condyle of the humerus, and are generally united to the triceps muscle ; the middle and lower fibres spring by a small round and strong tendon from the lower and back part of the outer condyle of the humerus ; this tendon passes along the side of the head of the radius, and must contribute to prevent luxations of that bone outwards, an accident of rare occurrence, but which has come within the vast experience of Sir A. Cooper.

At the inner and back part of this region, between the tuberosity of the condyle and olecranon process, is a furrow through which the ulnar nerve passes ; the exact course of this nerve is highly important to the surgeon ; it is seen first passing along the inner side of the front of the arm, on the inside of the basilic vein, and lying upon the triceps and brachialis muscles ; it finally proceeds obliquely towards the back surface of the inner condyle, in which is a smooth groove to receive it ; some fine cellular tissue merely separates the nerve from the bone, which, on account of the smoothness of the passage requires no additional protection ; it is a law that no nerves possess synovial membranes, these organs being reserved for parts exposed to much displacement and pressure ; the ulnar nerve is surrounded by a small quantity of adipose substance. This nerve being near the integuments, and placed upon a bony and resisting surface, is easily compressed, which produces a sensation too well known to merit notice. Sometimes, however, this nerve is not uncovered by muscular fibres. In my recent dissections, I have twice met with a small transverse muscle, about one inch in breadth, extending from the olecranon to the tuberosity of the inner condyle ; these muscles are perfectly independent of the triceps and flexor carpi ulnaris muscles. I am not prepared to say how often they may exist, nor what may be their use, unless to protect the ulnar nerve, and to raise up the capsular ligament and synovial membrane. The surgeon, however, might be a little surprised, if, in cutting down upon this nerve (with a view of following Scarpa's example of dividing it, for the cure of neuralgia; see his Opusculi di Chirurgia, p. 38), a transverse muscle should present itself; for this reason we have mentioned its existence; for, what in nature's sports occurs twice, may occur again. The ulnar nerve is easily separated from the cellular tissue, and made to slip over the tuberosity of the condyle, a precaution which ought always to be attended to in excision of the elbow-joint; for this nerve might otherwise be injured: and several such instances have taken place.

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[1] Page 247. Loc. cit. vol. ii.

[2] Dict. de Médecine, t. ix. p. 221.

[3] Anatomie Générale, p. 188.

The outer or radial projection which extends from the front to the back of this region, is composed of the supinator and radial muscles. It is generally described as being formed principally by the supinator radii longus muscle, but this is not exact. The supinator longus muscle presents two distinct shapes; above the bend of the elbow its superior extremity is flattened sideways, and fills up the space on the outer side of the arm which exists between the triceps, biceps, and brachial muscles; but when the supinator longus reaches the situation of the head of the radius, it becomes flattened in the opposite direction, from before backwards, taking thus the shape of the subjacent extensor radialis longior muscle, upon the anterior side of which it lies; and cannot for this reason, form alone, the radial eminence, as many writers assert. The extensor radialis longior has rather a thick belly; it lies immediately upon part of the supinator radii brevis; it covers the radial nerve; it is in contact with the front side of the outer condyle of the humerus, and with the outer border of the brachialis anticus muscle. It is this muscle principally which contributes to form the radial projection. In this situation we find the radial nerve, which first lies on the outer side of the brachialis anticus muscle, and covered by the supinator radii longus; lower down, this nerve is bounded on its inner side by the tendon of the biceps muscle, which separates it from the brachial artery and veins, and from the median nerve. The recurrens radialis artery and veins lie on its inner side. This nerve passes over the supinator radii brevis, where it gives off several branches which supply the neighbouring muscles; and lastly, divides into two principal branches, one of which dives under the supinator radii brevis muscle. The radial nerve is generally surrounded by a good deal of adipose substance; nevertheless, it will be easily understood, that in dislocations of the head of the radius, this nerve must experience more or less compression, and hence the pain in the thumb and fore-finger can be accounted for. The other muscles, which insert themselves into the outer condyle and contribute to the formation of this region, as well as to the strength of the radial articulation, by their fibres being intimately connected with its ligaments, are the extensor digitorum communis, the extensor carpi ulnaris, and the anconeus muscle. This last muscle has sometimes been considered merely as a part of the triceps muscle, on account of the origin, direction, and insertion of their fibres being nearly similar; nevertheless, this small muscle is attached chiefly along the outer edge of the ulna from its middle to the top of the olecranon, where it is intimately connected to the triceps fibres; it arises by a small round but strong tendon from the external condyle of the humerus, and passes over the side of the head of the radius; this tendon gives considerable strength to the articulation. M. Malgaigne has fallen into a singular mistake with regard to this muscle, which he describes as lying on the inside of the olecranon, and as covering the ulnar nerve. The error here is not simply typographical, as it consists in placing the muscle on the wrong side of the articulation.

The arteries surrounding the articulation have been already noticed in the operations for aneurism; it will be, therefore, unnecessary to dwell on them in this place. It sometimes happens in wounds of this region that one of these small arteries is divided, and may be productive of serious bleeding; attempts have been made to arrest the hæmorrhage by enlarging the wound, and securing the mouth of the bleeding vessel; an operation which has sometimes succeeded. Sometimes, however, it is quite impossible to secure the artery; hence many surgeons prefer tying the brachial artery in the arm. In such a proceeding, where should the ligature be placed? This must depend upon the vessel which is wounded. Suppose, for instance, it were probably the external collateral branch, just above the outer condyle of the humerus; here it would be prudent to tie the brachial artery high up before it gives off this collateral branch; if, on the contrary, the bleeding were caused by the injury of the ramus anastomoticus, or recurrent branches, tying the artery about two inches above the inner tuberosity of the condyle of the humerus would be sufficient; it is perhaps for not attending to these anatomical reasons, that such hæmorrhages have not been arrested by the ligature of the brachial artery.

(C. Tarral.)

ARMAMENTARIUM, *arsenal*, Fr., adopted by old surgical writers to denote a general magazine of instruments and surgical apparatus, and hence taken by Scultetus and others as the title of their works treating of all that relates to this province of surgery.

ARSENIC, *arsenicum*, Lat.; *ἀρσενικὸν*, Gr.; *Arsenik*, Ger. Arsenic of commerce is the arsenious acid of the chemist. It exists native, and is procured abundantly during the extraction of other metals from their ores, more particularly cobalt. This ore is thrown into a furnace to which a flue or horizontal chimney is attached, through which, during an exposure to heat, the fumes pass, and are condensed into a greyish or blackish powder. It is afterwards purified and consolidated by sublimation in large iron mattrasses. It is then brought into the drug market under the appellation of white arsenic, in large colourless inodorous masses, which are generally opaque; when recently broken their internal structure presents a vitreous appearance. It is volatilized at the temperature of 383° F., and emits a smell somewhat resembling that of garlic; but when carefully heated, far from the contact of any substance that can decompose it, this alliaceous smell, which has been by some regarded as a test, is not perceptible. Its specific gravity is 3·7. Its taste is strikingly nauseous; it creates a singularly astringent sensation about the mouth and fauces, and excites a flow of saliva and a painful sense of constriction. It has been called arsenious acid very properly, for it unites with potash, ammonia, and soda, forming soluble compounds; one of these, the arsenite of potash, is introduced into our pharmacopœias under the name of liquor potassæ arsenitis, or Fowler's mineral solution. This has gained great reputation in the cure of diseases of an intermittent type. The French Directory, during the march of the French army through the marshy plains of Lombardy, issued a decree commanding the surgeons, under pain of military punishment, to employ a similar preparation of this mineral for the soldiers who were suffering from intermittent fever, produced by malaria. Arsenic has long been employed in the treatment of cancer, and has at different times been highly extolled, and at others as much depreciated; it has formed the basis of almost all the quack remedies which have claimed any reputation in the cure of the disease, and various articles have been employed to disguise it from the patient. Fuchsius united it with soot and serpentary, and Richard Guy, with sulphur, hog's fennel, and soot. Its topical employment is chiefly indicated in cases of cutaneous cancer; and it should be steadily repeated till every trace of the disease be removed. In proportion to the degree of inflammation excited is the chance of its absorption diminished, and the risk of deleterious consequences precluded. Messrs. Sachs and Dulk assert, that its erosive power is greater than that of any other known remedial agent, with the exception of fire; and that of all potential cauteries, it most efficiently obviates the absorption of the morbid virus. They also mention their having known numerous instances of a perfect and lasting cure having been wrought by its means in cancers of the skin. Failure was to be attributed to its untimely application[1]. It is only as a caustic that arsenic acts beneficially in such cases; since there is no good evidence of its internal administration having proved serviceable.

Mr Carmichael has promulgated some peculiar notions on this head, in his work on Cancer, to which we must refer our reader. It must always be remembered, that the utmost danger from absorption of the poison into the system attends the external application, and that the powder sprinkled upon the sore often produces intense pain, without exciting any other remarkable symptom, whilst, again, on other occasions violent inflammation and local irritation have suddenly supervened. Roux narrates the case of a young girl aged eighteen, who died in consequence of the application of the *pâte arsenicale* to a cancerous breast: it has been found, from experiment, that inflammation is produced in the stomach of the dog, not only more violently, but more rapidly by the application of arsenic to a wound, than where it was given internally, every precaution having been previously taken that no delusion should arise from the animal being suffered to lick the denuded surface.

In hospital gangrene, the solution of arsenic is found most valuable. Mr. Blackadder, during the Peninsular war, employed it at Passages with the happiest effect, and Hennen, in his Principles of Military Surgery, gives a long description of the plan that was followed: — The first step is to make the sore perfectly clean, and freed from the viscous discharge; but as this cannot be easily effected by common means, without occasioning a disagreeable oozing of blood or a considerable degree of pain, the ablution is made from two large hospital teapots, one containing a hot solution of the subcarbonate of soda, the other a cold one, that the one or the other may be employed as the feelings of the patient for the moment dictate; the glutinous matter which adheres to the sore may be gently detached by means of small dossils of lint: sponges are to be avoided, in consequence of the expense, for the dread of contagion must prevent their being employed more than once: dry lint may be spread on the surface of the sore, as soon as it is perfectly clean, and removed, and fresh lint applied until the sore is perfectly dry. The solution of arsenite of potash, diluted with an equal part of water, is then applied through the means of pieces of lint, which are to be well soaked, and renewed every fifteen minutes or half an hour; sometimes on the first application it is necessary, particularly in irritable or debilitated constitutions, to administer an opiate, and to repeat it according to circumstances. The use of the solution is to be continued until an insensible dark-coloured and dry slough occupies the whole surface of the sore, and until the patient is completely relieved from the burning and lancinating pain, which is in some degree characteristic of the disease. These cases require great personal attention on the part of the surgeon, as the application of the remedy in this form cannot be entrusted to the patient or his usual attendants, and every step of the manipulation demands great precaution, more particularly if the fingers of the surgeon be accidentally abraded.

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[1] Handwörterbuch der Praktischen Arzneimittellehre, Part I. p. 475.

The uncertainty of the effect of arsenic applied to ulcers has been assigned to different causes. Mr. Blackadder, who states that he never saw more than one instance of its deleterious operation, although he had for a length of time employed it, attributes his success to his having always applied very large quantities, which he believes very quickly destroy the organization, and necessarily prevent the action of absorption. Harles remarks that it is perfectly innoxious when applied to an abraded surface, to sores, or to malignant ulcers, even in a high state of irritation, provided the part be not recently wounded, and that no blood issue from it; for it is by the direct application to the open vessel that it is absorbed, and that with the same certainty and rapidity as if it had been injected into the vein. The powder of Frère Côme, Plunket's powder, the pommade of Hellmund, are the compositions applied to the ulcers of the face and nose, which occasionally commit such ravages; these preparations generally produce eschars, and considerable pain and tumefaction. Dupuytren has therefore given some formulæ, which possess a different mode of action, and modify the effects. For this purpose he employs calomel; he recommends a powder formed by mixing one part of arsenious acid with ninety-nine parts of calomel, sometimes increasing the proportion of the arsenic to five or six parts. His liquid preparation consists in the simple solution of arsenious acid and calomel in distilled water, or in the form of a paste with gum, generally making the solution a little stronger than the powder. The *pâte arsenicale* has one part of the arsenic to thirty-two of fatty matter. The powder of Rousselot consists of one part of arsenic, sixteen parts of the red oxide of mercury, and eight parts of the resin of Pterocarpus Draco, which has been said by Cullerier to prevent the absorption of the poison.

During the internal administration or external application of arsenic, great attention must be paid to the state of the digestive organs, for should a gastro-enteritic state supervene, other bad symptoms soon follow, and blotches on the skin rapidly becoming gangrenous, or paralysis of the lower limbs, quickly evince the poisonous effect. This drug should not be combined with any acid. The dose, at first, should be very small; the sixteenth of a grain twice or thrice a day is quite sufficient to commence with, for three quarters of a grain have produced sensations of constriction at the throat, spasms, diarrhœa, or vomiting: very little more should be left in possession of the patient than may be required. It is best to exhibit it immediately after a meal, when the stomach contains food. Should any bad effects follow, opium may be exhibited; and, if inflammatory symptoms supervene, blood-letting, both general and local, ought to be employed. Orfila has recommended sulphuretted hydrogen condensed in water as a direct means of counteracting its virulence. More recently, hydrated sesquioxide of iron has been proposed as a chemical antidote by MM. Berthold and Bunsen; and several cases have been recorded of its efficacy. But little reliance can be placed on lime-water or magnesia, although they are most generally recommended. In the copper-mines of Cornwall, sweet-oil is employed as a preventive to the bad influence of the arsenical vapours. The effluvia from arsenic is said to be destructive to those who for any length of time are exposed to it; both animals and vegetables are materially affected in the neighbourhood of copper-mines, but it is stated that in aguish countries, it is a preventive to the development of intermittent fever. During the plague at Marseilles, arsenical fumigations were tried, but Chirac pointed out their deleterious agency.

(*George G. Sigmond.*)

ARTERY, ARTERIES, 'Αρτηρία, Gr.; *Arteria*, Lat.; *Artère*, Fr.; *Pulsader*, *Schlagader*, Ger. The arteries are the canals or tubes which serve for the transmission of the blood from the ventricles of the heart. They arise from it by two trunks—that from the right ventricle, called the pulmonary artery, supplies the lungs—that from the left, (the aorta) all the other parts of the body. From these two sources, they ramify into numberless subdivisions in an arborescent form. Considered as to structure, they possess three distinct coats; the external, or *cellular*, derived from the parts through which the vessel passes, and on which its power of resistance mainly depends; the *middle*, or *fibro-elastic* coat, consisting of transverse or circular fibres, of a yellowish hue, and strong in proportion to their proximity to the heart. This has been also called the *muscular coat;* and the *internal*, or *serous* coat, which forms the lining of these vessels. The two latter coats are much more fragile than the first, and between them the *vasa vasorum* may be traced.

The characters of each of these coats are perfectly distinct. The cellular tunic is thick, filamentous, and compact. The middle tunic is firm, dry, and elastic, its fibres being arranged in concentric layers, having a slightly oblique, or spiral direction. It is to the firmness of this tissue that the cylindroid form of arteries is chiefly owing, while its elastic properties confer a power of accommodation to the varying volume of blood transmitted through these vessels. This tunic is found in all arteries, even in those of the brain, and is only rendered indistinct from the diminished size of the vessels. The internal tunic is smooth, polished, moist, and when separated, transparent; it is also firmer and thicker in the arteries than in the veins and lymphatics; and contributes chiefly to form the various valves of the vascular system. Some anatomists contend for the existence of a cellulo-nervous coat between the internal and middle tunics, relying for the proof of the fact on the frequent development of calcareous or other formations in this situation, as well as on their power of demonstrating its presence between the lining membrane and the muscular substance of the heart.

The colour of the large arteries is a whitish yellow; that of those of middle size, reddish; while in the very small arteries, it is nearly red. They are plentifully supplied with minute blood-vessels, the *vasa vasorum*, and with nerves, chiefly from the ganglionic system, which may be distinctly traced twining round the large vessels, especially in the cavities of the thorax and abdomen.

The question whether arteries possess contractility independent of the heart, though denied by many very eminent physiologists, is now resolved in the affirmative. The action of these vessels is a compound, of contractility derived from the fibrous or proper tunic, and of retractility from the cellular coat; all their tissues are extensible, though in different degrees. In consequence of these powers in the coats of arteries, the progression of the blood through them is promoted; their pulsations however are isochronous with the contractions of the ventricles, and are chiefly dependent upon them.

The doctrine which referred all the various morbid alterations of arteries to chronic inflammation of their tissues is now no longer admitted. The degenerescence of these vessels, like that of other tissues of the body, results from causes obscure in their action, it is true, or altogether unknown, but nevertheless partaking by no means of the nature of inflammation, but seeming rather to depend, at least in the case of the arteries, on that slow and gradual modification of nutrition which seems to keep pace with the advancement of age.

Arteritis, or *Inflammation of Arteries*[1].—The study of the intimate tissues of our organs has accomplished the same results for the pathology of the arteries, as it has for any of the other organs of the economy; that is, it has enabled us to recognize the different susceptibilities of the several arterial tissues, and their liability to be affected separately, successively, or conjointly. But we do not mean to say that the light shed on the affections of the arteries is equally great, as in the instances of other organs, for, on the contrary, notwithstanding the attention that has of late years been bestowed on the pathology and surgery of the arterial system, perhaps but little progress has been made, as regards the idiopathic alterations of condition, that occur in this order of vessels. The structures that enter into the composition of an artery, seem not to be very susceptible of inflammation, but of course in this respect there must be some variety; the tissue that appears to be endowed with the greatest power of resistance to it, is the middle fibrous, or elastic coat, whilst that which resists it the least is the internal membrane with its subjacent cellular tissue. But, so far from easily assuming the inflammatory process idiopathically, arteries are often seen traversing the cavities of tubercular abscesses, exposed in extensive, and even phagedenic ulcerations, without participating in the disease; and when they happen to give way and burst, it is from being extensively denuded of their cellular coats, and thus deprived of nutriment. An artery examined under such circumstances, shows no increase of vascularity, nor any of those appearances that are said to depend on inflammation. On the other hand, the internal coat, which many regard as analogous to serous membrane, is often found red and vascular, with deposits of various kinds, either on its surface or between it and the fibrous tunic.

From their general insusceptibility of disease, therefore, it may not be unfair to assume, that idiopathic arteritis is of rather rare occurrence, and even when present, it is doubtful whether it be accompanied by symptoms sufficiently clear to establish a satisfactory diagnosis. True, when it has produced its lamentable and too often incurable effects in the development of aneurism, it may then be presumed to have been in existence at an earlier period; but now the appearances of inflammation have passed away, and an autopsy may show alterations of structure, of shape, or of dimensions in the vessel, but nothing explanatory of the first and early deviations from its state of health.

There is another circumstance which adds to the difficulty of these investigations. Arteries, particularly the large ones, are often found deeply dyed internally; and this appearance has been generally, and I believe properly, attributed to transudation. By the experiments of Rigot and Trousseau, moreover, it has been shown that in some instances the aorta, when slit down its entire length, although on its first being exposed to the air, it presented its ordinary pale colour, soon assumed a deep crimson hue, without having been in contact with the blood; and, again, when immersed into water, the natural pale straw-colour of the aorta was restored. Such being the fact, how can a difference be discovered between the two cases, one the vascularity of inflammation, the other, the mere physical result of transudation, more especially when, as it has been already observed, the history of the case throws no *certain or positive* light on the dissection. The depth of colour will afford no assistance, as it may depend on the length of time that has elapsed since death, and a number of other causes. There is nothing like distinct vascularity in an inflamed artery; nothing like separate, injected, and distended vessels, as in an inflamed conjunctiva; the redness is broad and patchy, and may be removed by immersion in water, or by washing, as perfectly and perhaps as quickly, as that produced by transudation. Under such circumstances, I should hesitate to pronounce any appearance of redness on the internal surface of an artery, as indicative of inflammation, unless it were accompanied by other phenomena generally taken as the results or effects of this process on the arterial structure, such as thickening, friability, and softening, and some of which, it is probable, are developed with great rapidity, and at an early period. At the present day therefore, there are but few if any pathologists who are disposed to interpret the simple red coloration of the lining tunics of arteries as conclusive evidence of inflammation; or to maintain with Franck, that it is pathognomonic of inflammatory fevers.

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[1] This subdivision of the article, down to the bottom of p. 382, has been furnished by my friend Mr. Porter of the Meath Hospital, Dublin.

Causes :—As external causes are known to to have but little influence in exciting inflammation in the arteries, in which respect their difference from the veins is very remarkable, it is assumed that the abuse of spirituous liquors, mercury, &c. may lead to its development.

But whether it is thus produced, or not, the symptoms to which it gives rise vary exceedingly in intensity: they may be as obscure as when a ligature is applied on a vessel, producing neither local inconvenience, nor reaction of any kind; or the fever may run high, with severe pain in the course of the affected vessel. When this is the case the danger to the limb, and even to life itself may be very great. The artery is exceedingly painful, and like a chord to the touch; the pulsations may still continue, or be almost wholly obscured; the limb swells, becomes covered with phlyctenes, and falls into gangrene, or, as has been observed by MM. Graves and Stokes, is for a time partially paralysed.

This variety in the degree of intensity of the inflammation, is not alone referable to its occurrence in different individuals; for even in the same individual, one inflamed portion of an artery shall have poured out coagulating lymph, and be in full progress to obliteration, whilst another shall not exhibit a single particle of lymph, or indicate the slightest tendency to this process. But I shall not dwell on this point now, as an opportunity will be afforded for discussing it in another place; for the present, it will be sufficient to remark that as these effects evidently tend different ways, one towards the safety of the individual, and the other, too often, to his destruction, it may not be altogether improper to designate these forms of inflammation by the terms, *healthy* and *unhealthy*. The healthy is very generally the result of accident, or injury: the unhealthy, as may be anticipated, is more frequently idiopathic.

The supposed consequences of arteritis may be arranged into two classes, one, as they occasion alterations in the structure and functions of the vessel itself: the other, as inducing disease in different and distant parts. According to Cruveilhier, the essential character of commencing arteritis is the coagulation of the blood within it. This is observed in the healthy or adhesive inflammation occasioned by a division of, or the application of a ligature on, a vessel, when a coagulum is found to occupy the interspace between the ligature and the next collateral branch: but is still more remarkable in the unhealthy or spontaneous, where it is the most frequent cause of the gangrene that occurs in old persons[1]. That coagulated blood is generally found after death within an inflamed artery is well established by dissection, but that this is the result of the inflammation is more than questionable. In a case that occurred in the Meath hospital[2], and which was accompanied by the senile gangrene of the toes and feet; the femoral artery, which was greatly enlarged, was found after death filled with a coagulum, but during life the blood unquestionably circulated through it, the motion imparting to the finger the sensation of a weak and indistinct thrill like that felt on touching the course of the urethra whilst the urine is passing. In another case treated in the same institution, where a ligature had been placed on the femoral artery, the segment below the cord exhibited the deepness of colour and the increased calibre of an inflamed vessel, but contained not a single particle of coagulum of any description, although there was no collateral branch within a considerable distance. Under these circumstances, and seeing that the aorta, at its arch or even before the arch is formed[3], is often the seat of inflammation, in which case the whole circulation should be stopped, it may be doubted whether the formation of a coagulum is an effect of inflammation during life; that which is found after the application of a ligature being the result of the stagnation of a small quantity of blood between it and the next collateral branch.

The early effects of healthy arteritis on the vessel itself, are scarcely appreciable by our senses, except in experimenting on animals, a mode of investigation, that will be found very inadequate to explain the effects of disease in the human subject. In Jones's experiments I do not find any mention made of the condition of the vessel with respect to an increase of vascularity, and in some trials of my own I could not say, whether the redness observed, was the result of transudation or not. In man, it is not easy to obtain an opportunity for satisfying ourselves on this point, but judging from analogy, it may not be unfair to assume, that arteritis is ushered in by an increase of vascularity and of redness, followed, however, very speedily by an effusion of organizable coagulating lymph on the surface of the internal membrane; which, if the surfaces are laid together, will in a short space so glue and fasten them, as to close the vessel at that point. So far, then, a healthy inflammation of an artery *terminates* by a species of union by the first intention, and whatever other results have been attributed to this cause, they may probably be more easily explained by referring them to a different source. It has been supposed by high authority, that the obliteration of large tracts of arteries, such as of the umbilical arteries, and the ductus arteriosus in the infant, and of the interspace between a ligature and the next collateral branch in any subject, is the result of a certain species of healthy inflammation; but these phenomena are so unlike the effects of an inflammatory process as generally observed, that it is difficult to ascribe their occurrence to this cause. What evidence is there of the existence of inflammation in the umbilical artery of the infant, and if it did take place, would the result be the obliteration of the vessel[1]? What is there in the casual existence of a collateral branch to check the sporadic tendency of inflammation, and limit its extent within a given space, perhaps within the one-eighth of an inch or less? It may, after all, be only quibbling about a name, but I would rather attribute this phenomenon to a general law in the animal economy, which tends to the closure of all canals when no longer permeated by the substances for which they were designed to afford a passage: a law, the operation of which is seen in the closure and obliteration of veins as well as arteries; in the diminution of the calibre of the lower portion of the bowel where an artificial anus exists; in the contraction of the urethra in fistula in perineo; and in many other cases, which it is now unnecessary to specify. It will be seen hereafter, that the tendency of arteritis is rather to increase than to diminish the size and capacity of the affected vessel.

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[1] Dictionnaire de Médecine et de Chirurgie Pratiques; tom. iii. pp. 394, 395. Article, Maladies des Artères.

[2] The phenomena and results of this case attracted considerable attention amongst the medical attendants and were particularly remarked by my friend and colleague Dr. William Stokes. The preparation is in the museum of the Park st. school.

[3] See Dublin Journal of Medical Science.

The very early symptoms of the unhealthy inflammation of arteries are not known. In some instances, acute and severe pains have been experienced before the appearance of internal aneurisms, but in others there has been even more satisfactory evidence of the existence of the disease without the patient's complaining of any suffering: I can therefore only avail myself of examples in which the disease was fully formed, in order to describe its appearances and effects. When an opportunity is afforded of examining a vessel in this condition, and its coats are slit up longitudinally, the internal membrane appears to be of a bright crimson or carmine colour, varied with small spangle-like patches of a paler and more opaque tint. This vascularity is not confined to the lining membrane, for on removing this, the fibrous coat is seen also to be deeply stained. Between these, but more closely attached to the former (for it is removable with it,) is a deposition of a soft cheesy steatomatous material, which being seen through the lining membrane, gives it that patchy appearance already mentioned. An artery in this condition is remarkably increased in calibre[1]; its properties, both of contractility and elasticity are diminished, and it easily breaks down and tears, under an extending force that would have little or no effect on a vessel not the seat of disease. Probably in a very short time after the formation of this steatomatous deposit, ulceration commences in the lining membrane, which, proceeding from within, erodes the middle tunic to a greater or less extent of depth, and thus leads to the production of aneurism.

The symptoms that indicate the presence of arteritis, have not been clearly laid down, and moreover are such as might easily be overlooked, if not sought for by a careful and even rigid examination. It has been already stated that the previous occurrence of pain is not a satisfactory diagnostic. In the case of inflammation of the femoral artery already alluded to, Dupuytren stated, that a dull heavy pain had been previously felt in the iliac fossa of the same side, from whence it descended along the internal part of the thigh, then to the posterior part of the leg, and finally reached the sole of the foot and the toes. He also speaks of the patient having been annoyed by cramps, and in general, persons suffering from aneurism of the aorta accompanied by inflammation complain of pain in the back, stitches in the side, and spasms in different parts of the chest. Where gangrene is threatened, the temperature of the limb is diminished below the situation of the inflamed artery, and the coldness is felt to be increased in intensity as the examiner proceeds downwards, the sensibility being impaired exactly in the same proportion. On laying the finger over the course of the vessel, its pulsations are found to be weak, tremulous, and indistinct, the artery in its entire course appearing to be converted into a hard incompressible cord[2].

As a consequence of arteritis, suppuration within the vessel must be of rare occurrence; nevertheless it may be met with, either occupying the whole calibre of the artery for a given space, as in the case already quoted from Cruveilhier, or more generally in the centre of, or intimately mixed up with clots of fibrine or coagulable lymph. In no case, that I am aware of, has purulent matter been found mixed with the blood in the arterial circulation: neither do I know of a single instance of gangrene of the vessel itself supervening as a consequence of idiopathic inflammation.

The treatment of arteritis has not been distinctly explained, farther than that it should be antiphlogistic in the fullest acceptation of the term. When it is acute and of a healthy character, tending to adhesion and obliteration of the vessel, it should not be interfered with: Nature is about to perfect a salutary process, and ought not to be disturbed in her operations. Nothing is requisite in such a case but absolute rest; and when there is an accompanying wound, the surgeon should be careful in paying the requisite attention to it, not to permit any unprofitable meddling with the vessel. But in the unhealthy form of arteritis, and more particularly where it is idiopathic, I question very much whether the general and sweeping direction to treat it antiphlogistically, is either rational or scientific. Whether correctly or not, I have been accustomed to regard this inflammation as bearing a strong analogy with erisypelas, particularly in its sporadic tendency, in the kind of fever that often accompanies it, and in the class of persons it attacks. It ought to be borne in mind also, that inflammation of an arterial trunk in an extremity (the only situation in which it can be recognised,) is frequently followed by gangrene of the limb below it, and this is a process not likely to be arrested in its progress, or benefited in its treatment, by active antiphlogistic measures. I suppose, therefore, that arteritis is to be submitted to a course of management having relation to the age, constitution, and habits of the patient, the probable exciting cause of the malady, and the circumstances in which he may be placed with respect to air, diet, clothing, and those other numerous conditions, which, however superficially regarded, are constantly found to influence disease in all its forms. In some cases, perhaps, a rigid and general antiphlogistic treatment may be necessary; in others it may be more modified and more locally directed; and in others still it may be easily conceived that camphor, musk, ammonia, and wine might prove the most suitable and successful medicines. In any line of treatment, however, our present stock of knowledge is not sufficient to enable us to predict a favourable issue to any given case. The disease usually is completely formed before it is discovered, and when discovered, it is in consequence of the occurrence of aneurism, mortification of the extremities, or some other result, the importance of which throws the original exciting cause entirely into the back ground. The consecutive disease either occupies the surgeon's undivided attention, or if not, and he discovers the existence of the arteritis, he finds his interference has come too late, As far as I know, the records of surgery offer nothing cheering or encouraging in the management of this afflicting malady; but this, instead of diminishing our confidence in the resources of the art, should rather stimulate us to further exertion, in order to render them available. For this purpose the etiology of the disease should be carefully studied, and the early symptoms so described and arranged, that they may be easily discovered at the only period at which medical aid can be advantageously resorted to; namely, at the commencement.

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[1] "I have seen the body of an infant some days old, in which, the umbilical artery, *greatly dilated*, was filled with pus to the extent of nearly two inches." Cruveilhier, loc. citat.

[1] Dupuytren has related a case, in which the artery was found in the opposite condition. "A la partie moyenne de la cuisse l'artère, quoique d'apparence normale, était rétrécie, occupée par un caillot presque filiforme, rosé, et qui parut s'être formé après la mort. Leçons Orales; tom. iv. p. 489.

[2] This does not exactly correspond with my own experience, for I have felt the artery of the thigh during life, and satisfied myself that it was greatly enlarged; a diagnosis that was verified afterwards by dissection.

Having paid a considerable degree of attention to the pathology of aneurism and other organic lesions frequently met with in connexion with that disease, and having satisfied myself that arteritis was one of its immediately exciting causes, I have latterly investigated the history of every case that presented itself, and have come to the conclusion that intemperance, particularly in the use of ardent spirits, and repeated or ill-conducted courses of mercury, were most generally and most intimately connected with the production of arterial inflammation[1]. This latter medicine is seldom used in great quantities, or for any protracted length of time, unless for the cure of syphilis, and hence many have entertained an opinion that arteritis might be a result of the operation of the venereal poison. In this supposition, I find Scarpa, Richerand, Corvissart, and to a certain extent Mr. Hodgson, seem to coincide[2]. Dupuytren, in examining arteritis in connexion with gangrene of the extremities, states that it is found almost always in persons that have indulged too freely in spirituous liquors, in stimulating food, and in those who have suffered from chronic diseases of the heart, or of the aortic valves or great vessels[3]. Bouillaud, amongst the other causes that may produce inflammation generally, enumerates fatiguing and continued exercise, stimulating drinks taken in too great quantity, and the abuse of spirituous liquors as particularly conducing to arteritis[4].

However occasioned, it tends to the one invariable result, the creation of a dilated or aneurismal condition of the vessel itself, and hence it may be regarded as a pathological condition to which the arteries of persons in very early life are not subject. It has recently been adduced by Cruveilhier, Dupuytren, and others, as the immediately exciting cause of a particular form of gangrene, which attacks the extremities, and which, according to these pathologists, is produced by the stagnation of the blood within the inflamed vessel. I have seen some cases of mortification of the extremities in connexion with arteritis of the leading trunk of the limb, and I have used the term, "particular form of gangrene" here, because I believe it to be by no means identical with the affection known in this country as Pott's mortification of the toes and feet. It is much more rapid in its progress, and consequently, more extensively destructive; it often destroys the integuments of the part engaged, a long time before the deeper structures are attacked; it is infinitely less painful, but, at the same time, I believe it is infinitely more dangerous. This, however, is not the proper place for the discussion of this part of the subject, and the reader must be referred to the articles Gangrene, Mortification, &c. &c.

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[1] Cyclopædia of Anatomy and Physiology; article, Pathological Conditions of Artery.

[2] Hodgson on the Diseases of Arteries and Veins, p. 9, 10.

[3] Leçons Orales, tom. iv. p. 483.

[4] Dict. de Méd. et Chir. Pratiques, tom. iii. p. 413.

The little tendency evinced by arteries to be affected by the morbid changes which may be going on in the tissues or organs through which they pass, has been already alluded to in the commencement of this article. It does not, however, amount to an entire exemption in their favour from attacks of this nature; and hence we find their coats soft, and extremely friable where they traverse cancerous tumours or other diseased structures. In such cases, their cohesiveness is greatly diminished, so that they break under the fingers, or they feel soft and sometimes spongy. There are even instances on record, in which erosion, propagated from a neighbouring bubo, has attacked the artery, giving rise to fatal hæmorrhage. Mr. Hodgson mentions a case of fatal hæmatemesis, where the coronary artery of the stomach had been eroded from an ulcer of the mucous membrane of that viscus; and the same thing has been observed to occur in the lungs.

Aortitis.—In connexion with the preceding observations, for most of which I am indebted to Mr. Porter of Dublin, who has so successfully cultivated this department of pathology, it will be proper here to refer to the recent researches of M. Bizot of Geneva, on this interesting subject. These researches, conceived on an extensive scale, have been conducted with remarkable ability and zeal, and are recorded in the first volume of the *Mémoires de la Société Médicale d'Observation.* M. Bizot had observed but one form of alteration resulting from an acute attack of the internal lining of arteries. It showed itself upon the surface of this membrane in the form of an albuminous exudation, varying in thickness, as well as in consistence, and resembling jelly, being smooth, transparent, limpid, or rose-coloured. In some instances, the transparency of the adventitious membrane was such as to allow the pale colour of the artery to be distinguished beneath it. If a portion of the lining membrane be raised and torn off in the direction of the new deposit, the latter, behind which it is placed, and from which it may be separated, tears off with it. These exudations were in general confined to one spot, but they were also observed in scattered groups or patches of various sizes, and in some cases the transparent matter was so abundant as so fill up completely the calibre of the vessel. It is very frequently found at the orifice of the arteries arising from the arch of the aorta, of the cœliac, mesenteric, and renal arteries, and on the posterior surface of the aorta, obliterating partially or completely the orifices of the intercostals. Sometimes the albuminous spots appear puckered round their edges, which made Mr. Hodgson liken them to atrophied hernial sacs. When this matter exists in the form of isolated patches, it probably does not give rise to any general symptoms; but the case is just the reverse, when the morbid secretion is thrown out extensively on the internal surface of the large arteries. M. Bizot thinks that acute aortitis occurs in this way, and cites three examples observed by himself; the disease, in each case, terminating fatally. The symptoms observed were œdema accompanied by fever, but without any disturbance in the functions of the heart, or of the other organs essential to life; and these symptoms he considers as indicating the extensive development of false membrane on the internal surface of the aorta. These cases are recorded in M. Bizot's Mémoire; and we insert them, in order that by directing attention to them, his views may be confirmed or modified by other investigators.

"A young physician, aged 27, with light blue eyes, brown hair, fair delicate skin, pale complexion, good constitution, residing in Paris since 1829, having never been attacked with any serious disease, had since that period complained frequently of loss of appetite, and occasional diarrhœa, but without emaciation or loss of strength. He was in the enjoyment of good health, when, in September 1833, he perceived, for the first time, that his legs were swelled. Rest in the horizontal posture produced no effect in lessening the œdema; but his appetite and strength remained unimpaired; his respiration was not hurried, even on ascending the stairs; there was no disturbance of the heart, which beat regularly, and with its usual force. He made light of these symptoms, employed no remedies, and pursued his occupations as before. The inappetency and diarrhœa had lasted eight days, when, on the 24th of October, after a long walk, he complained of great debility, with pain in the right iliac fossa, and a feeling of swelling in the abdomen. These symptoms were but the prelude to a severe rigor. He passed a restless night, and his strength, next day, was prostrated. The œdema, which till then had been confined to the lower extremities, had extended to the body, face, and arms. The pulse 120 to 130. In the two following days, the œdema diminished perceptibly; the stools had become solid, and with them was voided a fragment of a tænia; pulse 100, with exacerbation of the fever in the evening, but without rigor. Palpitation was complained of on the 26th, but never afterwards. The thirst was constant, and there was expectoration with a cough, which, however, had existed previously to the attack. During the two first days he was bled three times, to the extent of 16 ounces each time; Seltzer water, and other diluents, with ice, were also employed."

"28. Obliged to lie raised almost to the sitting posture, mind clear, no headache, voice strong, hearing unimpaired, no tinnitus, eyes natural, face pale and slightly œdematous, but without any expression of stupor. The body, as well as the upper and lower extremities, are infiltrated; the abdomen is meteorized; the skin is fair, presenting neither petechiæ nor sudamina, but covered with sweat. He has sufficient strength to raise the glass to his mouth, but can neither sit up nor change his place. He complains of his extreme debility, and pain in the armpits, when moderate pressure is made on this region. The tongue is moist, rose-coloured ; the teeth are not dry, nor fuliginous ; there is no nausea, no vomiting. The thirst is great, the colour of the pharynx natural, there is no pain or pressure on any part of the abdomen, no diarrhœa. The urine is scanty and high coloured. The liver does not project beyond the margins of the ribs ; the size of the spleen is natural ; the heart does not extend beyond its ordinary limits ; the præcordial region gives a clear sound ; pulse regular and full, 120 ; respiration 24 in a minute, vesicular to the right, both before and behind ; sound clear on percussion on all this side. At the top of the left lung, and in front, the respiration is more feeble, accompanied with a sub-crepitant râle, and strong expiratory sound ; the percussion is somewhat less sonorous than on the right side. The mucous expectoration is soft ; in two or three, a few streaks of blood occur, but the spits are neither rusty, viscid, nor semi-transparent. (Digitalis and diuretic drinks ordered)."

"On the 28th, he passed an extremely restless night ; pulse 125. Eight ounces of blood having been abstracted, he obtained relief and rest. At five o'clock, A.M., however, he was suddenly attacked with excessive and suffocating pain, just below the margin of the left false ribs. The application of fifteen leeches, *loco dolenti*, procured some alleviation ; his intellect remained perfect, although he wandered continually ; pulse 120, regular and full ; respiration but slightly affected ; tongue moist, rose-coloured ; thirst still great. No increase of the œdema since yesterday ; urine scanty and turbid ; abdomen greatly meteorized. At eight o'clock, A.M., the pain shifted to the præcordia, and became much more intense. Fifty leeches were applied, and the pain soon ceased, but was followed by convulsions which only lasted a short time. His strength declined rapidly ; countenance cadaveric. During the day, an opiate procured sleep ; the breathing frequent, plaintive, and irregular. Towards evening the pulse became very feeble, and all the symptoms aggravated, although he did not seem to feel any local pain. His intellect remained unimpaired to the last moment. He expired on the 30th, in the morning."

"Autopsy twenty-eight hours after death :— Infiltration considerable in the upper extremities, still greater in the neck, which is of a violet colour, more on the left arm than on the right, moderate in the body and thighs, and slight in the legs and feet ; abdomen very much meteorized ; embonpoint unaltered ; skin tinged slightly yellow, and slightly ecchymosed on the back ; strong smell of putrefaction, no cadaveric rigidity. The pericardium contained four or five ounces of brown serum. The lining membrane of the anterior surface of the right ventricle, and the opposite wall of the pericardium, were studded, to the extent of two inches, with small soft yellow granulations, of the size of grains of sand ; these could be easily torn off, and beneath them the serous membrane did not present any appearance of injection."

"The heart of full size was extremely flaccid, and could be torn without difficulty ; the left ventricle was quite empty, its internal surface was of an ashy colour, presenting, near the aortic valves, small granulations, and a very thin, soft, yellowish membrane, which peeled off without difficulty, giving a rough appearance to the surface on which it had been formed ; this exudation was also spread on the aortic valves, which, though of a deep red, were still flexible. The aorta, throughout its entire length, was of a deep violet colour ; no capillary vessels, however, could be distinguished, nor did it contain either fluid or coagulated blood. The same granulations, and false membranes, were found in greater or less quantities throughout the whole length of the vessel, giving to its internal surface an unpolished appearance ; they could also be detached with the same facility. Similar alterations were found in the left crural artery ; that of the right side was of a violet red, but without granulations, or false membrane. The carotid and subclavian artery, though red, were healthy. The orifice of the aorta was natural, all the valves of the heart were flexible, the pulmonary artery, though red, was smooth and polished. In the right ventricle, there were no granulations, and very little blood ; even in the right auricle, there were but a few small clots ; the vena cava, the iliac and crural veins were also empty. Each pleura contained from four to five ounces of reddish serum. The right lung was free, the left was united laterally at its upper part to the pleura, by old bands of adhesion. There were neither tubercles, nor grey granulations, nor hepatization in any part of the lungs. There was slight emphysema along the thin edge of the left lung ; both lungs contained generally more than the usual quantity of blood, but there was no softening of their substance. The bronchial tubes generally were pale ; the bronchial glands, soft, deep-coloured, but not tuberculous ; the cervical were twice their usual size, soft, and of a greyish violet colour. The trachea was of a violet colour also, but without any other lesion ; the larynx was perfectly healthy. With the exception of an ounce or two of limpid serum, there was no effusion into the cavity of the abdomen ; the peritoneum was perfectly smooth."

"The stomach contained a little mucus, and was distended with gas ; its mucous membrane generally was of a greenish grey colour, with some darkish patches along the lesser curvature ; its consistence was firm, and thickness natural. The duodenum had a greyish hue ; the jejunum greatly meteorized contained a little yellow mucus, with long and numerous fragments of tænia ; its mucous membrane presented a few bluish arborizations, but was not much injected. Towards the end of the ileum, there was slight emphysema, but its consistence and thickness were natural; the glands of Peyer were bluish, dotted with grey, but not prominent; in the lower part of the intestine, numerous isolated follicles of the size of millet-seed lay scattered. The mesenteric ganglions were soft. There was some submucous emphysema in the cæcum; its lining membrane was greyish, thin, and soft, tearing in shreds half an inch long. In the rest of the intestine, the mucous membrane was also greyish, but there was neither injection nor emphysema; on tearing, it gave shreds an inch long, the mucous follicles were visible throughout. The bladder contained a little brownish fluid; its mucous membrane was pale. The cortical substance of the kidneys of a greenish hue was emphysematous, and on peeling off the fibrous envelope tore with it; the tubular substance was firm and of a violet colour. Under the peritoneum, covering the liver, were several emphysematous elevations; the organ itself was bulky, somewhat soft, and contained a saneous fluid, rather than blood; its parenchyma was of a pale green, and exhaled a strong odour; the gall bladder was full of bile of a golden yellow. The spleen was four inches long, slightly emphysematous, very soft, and of a deep brown colour. The head was not examined; but this does not affect the value of the case, as there were no cerebral symptoms observed during the disease, and, therefore, excepting the traces of pericarditis, which evidently had occurred on the 29th, there were no other lesions of importance but those observed in the arterial system, so that if we had nothing else but the description of the organs to enable us to form an opinion as to the cause of death, we should be compelled to ascribe it to an affection of the aorta."

All the circumstances of this case, it will be observed, had been closely watched, and even the existence of the false membrane had been indicated before death by M. Bizot to the other physicians who were in attendance with him. The diagnosis might have appeared a bold one, but he felt authorized to offer it, from his having previously, and in the course of his researches on this interesting subject, observed two other cases marked by the same peculiar symptoms, sudden acute œdema, with high febrile action, without any disturbance of the heart, or of the other important organs. To this assemblage of symptoms, therefore, taken in connexion with the existence of a false membrane covering the internal surface of the aorta, notwithstanding the smallness of the cases in support of his opinion, M. Bizot does not hesitate to apply the name of acute aortitis.

The exudation of acute character may vary, however, from the description given above, being, in some instances, more intimately adherent to the lining membrane, more firm, and of a milky white. Sometimes these patches resemble the hard boiled white of egg, and present the hardness of cartilage; in the latter case, the lining membrane can no longer be found. That they severally commence in albuminous effusion cannot, however, be doubted, for if, while in the soft state, they be subjected to ebullition, the most transparent of these exudations become firm, opaque, and white. Some authors have described them as being developed between the internal and middle tunics, but this is erroneous, as may be shown, by peeling off the latter with great care: the shred stops or breaks off suddenly on arriving at the edge of the cartilaginous patches, and cannot be continued over its surface. In regard to these cartilaginous patches, another error is prevalent, viz. that they ultimately become osseous. Now if such transformation ever occurred, the stages of the transition must surely be detected; but this is not the case. The source of this error will be pointed out hereafter. The last peculiarity of these exudations which requires to be noticed is, that they occur most commonly before or about the middle period of life, contrasting in this respect with other alterations of structure of the arteries, to be described hereafter.

We have now to notice another form of alteration, occurring in the arterial tunics, which, though presenting itself in specks and patches of variable extent, differs from the species above described, not only in its origin, but in its mode of development, and ultimate consequences. The alterations now under consideration, may be observed even in subjects under puberty, presenting themselves singly or in groups, as small specks or dots of the size of a grain of sand, and of a whitish yellow colour, round or near the orifices of the coronary, innominate, carotid, subclavian, and intercostal arteries. They are not elevated upon the surface of the internal tunic, but are seen through it, as neither the transparency, nor the consistence of this membrane is in the slightest degree affected by their presence, at least, while in this, which may be considered, their *rudimentary* state. If a shred of the membrane be detached and torn towards these yellow spots, the spots peel off with it, being slightly adherent to its external surface; but if the same attempt be made, after the spots have become confluent, and formed a patch of some extent, the yellow substance then adheres partly to the outer side of the shred, and partly to the middle tunic; hence it is obvious, that these yellow spots are developed neither on the internal, nor on the middle tunic, but between both. When they attain a certain size, as they frequently do in old age, they undergo various transformations, of which, ulcerous, or rather atheromatous softening and ossification are the principal.

The process of softening presents various stages. In the first, the internal membrane covering the patch is still unaffected, but the internal fibres of the middle coat, on which it rests, are more or less altered according to the degree of advancement which the process has attained; these fibres are softened, and differ in colour, being of a brighter yellow than the sound parts of the same coat. The patch itself appears to be slightly elevated, but there is neither redness nor injected vessels in its vicinity.

In the second stage, the patches are elevated, like pustules of an irregular or rounded shape, on the surface of the aorta to the height of a line or two. The internal membrane is still thin, transparent, and unaltered. On pressing these eminences gently, the finger perceives the movement of a semi-fluid matter. If the pressure be increased, the lining membrane gives way, and a yellow matter escapes, which resembles healthy pus; sometimes this matter is either moist or dry, and as it were farinaceous, or the mass seems as if it consisted of a quantity of minute, thin, shining spangles, some of them of a silvery, some of a golden hue. The matter being evacuated, the pustule disappears, and the internal membrane is depressed in the place it occupied. On removing this membrane, the internal surface of the middle tunic is found ulcerated, softened, and reduced to a firm, moist, yellowish detritus; several of the laminæ of this tunic are thus altered, but the healthy structure still exists towards its most external layers.

In the third stage, the pustules having emptied themselves spontaneously, small irregular depressions, with edges slightly elevated, are observed. The surface of these depressions is smooth, but exhibits here and there fissures or cracks. On removing this internal membrane, the softened matter and the alteration of the middle tunic just described will be found. In some instances, the internal membrane has disappeared, and the blood is in contact with the middle tunic.

If we now compare these several lesions together, we must at once perceive that they are nothing more than degrees of one and the same alteration, which originated in the small point which was first observed between the internal and middle tunics, and which at a later period becoming fixed to the latter, passed through the stages above described. M. Andral has described these pustules as small abscesses, but although the matter they contain has some resemblance to pus, it differs totally from it in the mode of its formation, and has a much greater analogy to that of softened tubercle.

The succession of these changes proves to demonstration that the alterations described under the various names of spots, pustules, abscesses, atheromatous, and steatomatous productions, &c. have one common origin, to wit, the almost imperceptible spot, developed without any trace of inflammation between the innermost and middle tunics of the arterial tube. Morgagni and Haller had already remarked this series of transformations, but they had included in it, the cartilaginous patches, the origin of which, as has been shown, is totally different. They fell into the same error, as regards the osseous productions; and this is easily accounted for, as very frequently both the atheromatous matter, and the osseous productions, are abundantly developed beneath the primitive cartilaginous patches. It may be here remarked, that out of the great number of ulcerations of the middle tunic, observed by M. Bizot, he only met with one, in which there was a commencement of aneurism; in all the others, there was always a layer, in some cases, no thicker than a leaf of paper, of the middle tunic remaining; in the case in which this membrane had entirely disappeared, there were partial dilatations on the arch of the aorta, corresponding to the points where the middle tunic was wanting. Writers have described steatomatous productions of the arteries. It is, however, unnecessary to repeat their statements on this subject, as these tumours are now considered by Mr. Hodgson and most modern authorities, as nothing more than aneurismal sacs, that have undergone spontaneous cure by the deposition of coagulable lymph.

Osseous Transformation:—The transformations of the primitive patches do not always follow in the order above described. Sometimes a hard semi-transparent point, of the same colour as the patch itself, forms in its centre, and increases slowly, more in extent than thickness, till it alters the structure of the middle tunic, as has been already described. The surface in contact with the lining membrane increases less rapidly, and a long period elapses, even when the osseous disk is of some size, before any remarkable change can be observed in this membrane. In some cases, however, it seems to be slightly thickened by a layer of albumen spread over the concretion. Ultimately, even this membrane is destroyed by the progress of the ossification, which then is in immediate contact with the blood. The yellow soft matter always surrounds the concretion, but no fibres can be discovered where they are in contact, the fibrous structure of the middle coat can only be detected by proceeding from the circumference of the concretion towards the sound portion of the artery. It is in the advanced period of life that these concretions are most commonly formed. But they have also been discovered in subjects of tender age. Mr. Hodgson mentions a case observed by Mr. Young, in which the temporal artery of a child only fifteen months old was found ossified, and Wilson met an instance of ossification in the aorta of a child only three years old. Bichat supposed that ossification never occurred in vessels through which black blood only circulated, and consequently that these concretions were not observed in the pulmonary artery. This, however, is erroneous. The instances, it is true, are very rare, but they have been observed, nevertheless, by several pathologists.

These concretions sometimes occupy the entire circumference of the vessel, but they do not form prominences on the surface of the arterial tube; they are often found surrounding the origins of the smaller arteries, and in such cases, they have the appearance of a ring, or if more extensive, of a hard cylinder, through the centre of which the vessel passes. It would seem, therefore, that the yellow patches undergo two different kinds of transformation, the ulcerous and the osseous; the latter, however, ought not, as Haller and Morgagni imagined, to be considered as a transformation, but rather as a simple deposition of phosphate of lime, occurring in the soft yellow matter, which, as Mr. Guthrie expresses it, forms its nidus.

But notwithstanding an undoubted difference of origin, the cartilaginous patches may be found in the same spot simultaneously with the ulcerous softening of the middle tunic, and the osseous concretions, and indeed their coexistence is by no means unfrequent. It is on this account, that some authors have supposed that the cartilaginous concretions were sometimes transformed into the osseous. On a careful examination, however, the error may be detected, as the ossification is never found, even beneath the white patches, without being surrounded by the yellow matter.

When these lesions occur in vessels of small size, the atheromatous matter is often so abundant, as to thrust the cartilaginous patches towards the axis of the vessel, thus diminishing its calibre, while at the same time it attenuates the middle tunic sometimes to a considerable degree, by the pressure which it makes upon it[1]. The effects thus produced upon the large and small arterial tubes, are very different; in the small ones, the albuminous secretion will tend to their obliteration, not so much from its own nature, as from the abundance of atheromatous matter, the deposition of which, in some cases, it seems to determine between the two internal tunics: obliterations of this kind are sometimes seen in the arteries of the inferior extremities. In the large vessels, on the other hand, the extensive development of the cartilaginous patches produces a different effect. Here, though the deposition of the atheromatous matter is in proportion less abundant, it involves more completely almost the entire thickness of the middle tunic, and hence the elasticity of the vessel is impaired, in the first place, by the extensive disorganization of the fibro-elastic coat; and in the second, by the development of the cartilaginous layer, which is itself inelastic. The large vessels in this state are reduced to the condition of almost inert tubes; their coats yield to the distending force, but are incapable of contracting again, and this doubtless will account for those considerable dilatations of the arch of the aorta, which are observed to occur without any aneurismal tumour.

M. Bizot had met but one case in which the middle coat was completely destroyed. The subject was a female forty-five years of age. The internal surface of the aorta was studded with cartilaginous patches, and there were several small aneurismal tumours on its external surface. On examining these tumours, the cavity was found lined with a thin membrane which was in contact with the cellular coat; the latter appearing almost transparent, and quite healthy, but the middle coat had entirely disappeared. M. Bizot, although he assents to the received opinion that the occurrence of aneurism is intimately connected with the morbid alterations of arteries, and the application of occasional causes, such as falls, blows, fits of passion, &c. nevertheless thinks, that other causes, the nature and action of which are still unknown, may operate in its production. He justifies himself in propounding this idea, on the observation of a fact, which we shall notice by and by, and which he terms the symmetry which seems sometimes to preside in the development of these morbid alterations.

Alterations peculiar to the arteries of the limbs:—These first appear as minute stains; they adhere to the middle tunic, and cannot be torn off with the lining membrane. Becoming multiplied they extend round the artery like a zone, and seem to be slightly depressed below the general surface of the cavity of the vessel; their adhesion to the middle tunic is so firm, that they cannot be separated from it, like the yellow patches in the large arteries, when we tear off a shred of the lining membrane. The fibres of the middle tunic at these points appear to be yellower, harder, thinner, less pliant, and more resisting. The transformation commencing immediately beneath the lining membrane, which it never affects, extends outwards through the layers of the middle tunic. The fibres at length are changed into depressed osseous, lines, which uniting, complete the entire circle of the vessel, and extend to various lengths upwards and downwards along its course. When the ossification of the middle tunic is complete, the artery is reduced to the condition of an inert tube, the external and internal tunics which are healthy merely covering both its surfaces. In undergoing this transformation, the middle tunic is diminished in thickness, so that the diameter of the artery becomes actually larger.

If we now compare this alteration with that already described, it will be found that they differ not only in their origin, but also in the transformations which they respectively undergo. The one originates in the minute yellow spot developed between the internal and middle tunics: the latter of which becoming thickened and softened, ultimately presents either the *ulcerous*, or the *osseous* transformation. In the other, the middle tunic alone is attacked, and ultimately becomes thin, transparent, and ossified. Instances, however, have been met with, where these two forms of alteration were found together, patches of the atheromatous matter extending beneath the lining membrane, and externally to them, the middle tunic being hardened, or converted in circular bony rings.

All these alterations generally increase in

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[1] Mr. Hodgson mentions a case in which he found the emulgent and femoral arteries thus obliterated from the great quantity of the atheromatous matter.

number and extent with the age of the individual, so that in advanced life, scarcely any subject is entirely free from them. Their effect upon the arteries, as we have already stated, is gradually to impair their pliability and elasticity, until they become totally incapable of either contracting or expanding. Now, this must affect to a considerable extent, the circulation of the blood within those vessels. The arterial tube has become inert, its surface rough and uneven, and its diameter enlarged. The movement of the blood is thus retarded, and as the force of the heart's contraction, instead of being in part spent, as formerly in dilating the large arterial tubes, is now transmitted entire to the smaller vessels, the blood is sent into the delicate structure of the remote organs with much greater force. In this way, doubtless, we may explain the augmented impetus of the pulse in persons who have attained a great age, and possibly this cause may contribute not a little to the production of those cerebral hæmorrhages so frequent in aged people.

In the course of M. Bizot's researches, he was struck with the fact, that whenever he found a lesion in an artery on one side of the body, the same kind of lesion would in all probability be found at the same point of the corresponding artery of the opposite side. With some exceptions, which might be easily accounted for, this symmetrical development of lesions was so constant, that he does not hesitate to characterize it as an invariable law in morbid anatomy.

TORTUOSITIES OF ARTERIES.

After the arterial blood is expelled from the heart into the aorta, it continues to circulate with the same velocity through the vertebral arteries and some of those primitive trunks contained within the thoracic and abdominal cavities, as that with which it was expelled from the central organ. Afterwards the velocity of the stream of blood undergoes various modifications in different vessels, which is necessary for the performance of the particular function of those organs in which such modifications are observed. Thus different organs are supplied with very different quantities of blood in proportion to their bulk, and in some the quantity varies even at different times. In some parts of the body, such as the tendons, the ligaments, and the muscles, they receive only such a quantity of the sanguineous fluid as is necessary for their nutrition, whilst the secreting and excreting glands are supplied with a quantity proportioned to the activity of their functions. The quantity of blood necessary for the stomach is different at different periods of the digestive process, and in the organs of generation it varies at different times, increasing or diminishing according as those organs are called into action. In order to effect these purposes in the circulation, the arteries are distributed in a variety of modes. Besides anastomoses, and the different angles at which arteries come off from the trunks, the different length of some arteries from the point at which they leave the trunk, until they reach the organs to which they are destined; their different positions in relation to surrounding parts; the tortuosities or flexures of arteries is another peculiarity by which the momentum of the circulation is modified in certain organs. The tortuosities of arteries have been generally supposed to have the effect of diminishing the velocity of the blood which is sent to particular organs, and though the serpentine course of an artery will, to a certain degree diminish the momentum of the blood, yet if the arterial canal be kept constantly full, the motion communicated to the blood by every contraction of the heart will be as great at the extremity of the tube as at its origin, except only an almost incalculable degree of loss caused by the increased friction of the blood, on the sides of the arterial tube, from the length of the windings of the canal. The impulse therefore which the central organ of the circulation communicates to the blood sent to any particular organ, must not be estimated according to the course or direction of the vessels which carry the blood, and the tortuosities observed in particular arteries, must therefore be intended to perform an office different from that of merely diminishing the velocity of the current of the blood. In order to ascertain what may be the effect of a serpentine course of an artery, we should enquire into the functions of those organs which are supplied with tortuous vessels. Some rectilineal arteries become tortuous when they are much distended, as may be observed after an artery is obliterated; in which case the collateral branches, besides increasing in size, also become more or less tortuous, or when an artery in the dead body is forcibly injected with a fluid, it in like manner becomes tortuous.

The arteries of the uterus have numerous flexures, which increase in proportion with the growth of the uterus during gestation. "They increase in size and in length before they reach the uterus, which obliges the spermatic artery in particular to be thrown into a serpentine form. This is more remarkable in some animals than in women." (*Hunter*)— In all these different cases of tortuosities of arteries, it appears probable that the flexures in the vessels are only the necessary consequence of its elongation; and their elongation being caused by the new growth of the part which the artery supplied, and not for any purpose of modifying the velocity of the blood. In a like manner may we account for the serpentine course of the spermatic arteries, their tortuosities being occasioned by the testis descending and elongating the artery. There are also tortuosities in vessels which are distributed to parts subject to alteration in their position, and to organs which are liable to great distension.

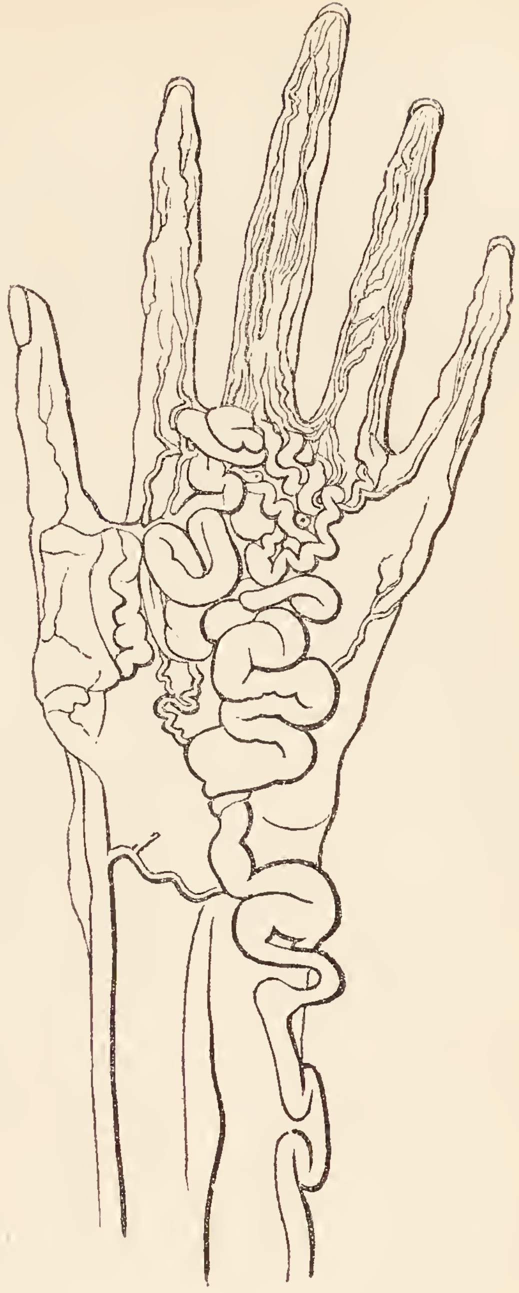
We have an example of the first condition in the face and lips—in those of the iris, intestinal canals, and likewise in the curvatures of the vertebral arteries, on their entrance into the cranium. The almost unceasing movements and change of position in these parts would compress and alter the form of the artery, and disturb the equality of the circulation, did not the vessels by their serpentine course readily accommodate themselves to such changes. Besides this influence of a tortuous course in an artery, there is another important effect produced by it on the circulation, and of which there are many examples to be found in the lower animals as well as man. The tortuosities of the vertebral arteries not only permit the various movements of the head on the vertebral column, without the circulation within the head being disturbed, but it is evident also they will prevent the weight of the column of blood, when the head is bent downwards, causing any pressure on the brain. After refuting the opinion of those physiologists who suppose the curvature of the vertebral arteries to have the effect of diminishing the impetus of the blood in the brain, Bichat concludes,—" Thus I am ignorant of the connexion which exists between the curvature of the cerebral arteries and the circulation of the blood within the head."—(*Anatomie Descript.*) In the lower animals there are many examples of arteries which have a tortuous course, in order to fulfil a similar purpose in the circulation of organs, which would be, more or less, subject to disturbance from the peculiar habits of the animal, if the pressure of a column of blood on such organs was not guarded against. There is a remarkable example of this in the spermatic arteries of the bull, and in the carotid and vertebral arteries of graminivorous animals, whose heads are necessarily much in the depending posture.

DILATATION OF ARTERIES.

The arterial varix, is a diseased condition of the arteries, which is very different from a true aneurism. In the arterial varix, not only is the whole circumference of an artery preternaturally dilated, but the enlargement sometimes extends along the whole artery of a limb, as well as many of its ramifications, or the trunk of an artery, such as the temporal, or occipital, with numerous branches, becomes so dilated as to form a tumour composed of a congeries of dilated vessels. The artery, in some instances, enlarges very considerably, acquiring many times its natural diameter, preserving its cylindrical form, and being equally dilated in every part. The tunics, in place of becoming thinner, as in simple dilatation, acquire additional thickness.

In the accompanying fig. is represented an arterial varix in the arm of an aged female. The ulnar artery enlarged and tortuous, and the radial artery also enlarged and lengthened. Both these arteries are seen forming several circumvolutions on the palm of the hand,—which anastomose and form globular aneurismal swellings.

Fig. 110.



(*W. B. Costello.*)

ANOMALIES OF ARTERIES.

There are several deviations in the origin and course of the principal arteries, with which it is necessary that the surgeon should be familiarly acquainted.

REGION OF THE HEAD.

The facial or external maxillary artery is sometimes so small as scarcely to pass beyond the angle of the jaw; at other times it extends to the forehead, and furnishes the lachrymal, palpebral, and frontal arteries. In the latter case, the surgeon might fall into error, by placing a ligature on the wrong trunk, were the frontal artery to be wounded. The facial artery may also ascend much nearer to the mental symphysis than is usual. M. Robert describes a peculiar disposition of the transversalis faciei, which deserves to be noticed in connexion with operations on the parotid duct; this vessel was double, one artery being placed above, the other below the duct, and both communicated by two small transverse branches. The transverse artery of the face arises, in some rare cases, from the external carotid, and crosses obliquely the masseter muscle to gain the angle of the mouth. The lingual artery is seldom the subject of operation, though it has sometimes been tied preparatory to extirpation of the tongue. It may arise by a common trunk with the superior thyroid, or more frequently with the facial artery. M. Maingault has endeavoured to determine the exact point at which the lingual arises; of thirty-six subjects examined by him, for this purpose, he found that the vessel was given off at the level of the os hyoides in twenty-one; and from one to eight lines above it in fifteen subjects. Two ranine branches of the lingual artery have also been found, a circumstance which would render an accident more likely to occur in bleeding from the ranine veins in glossitis.

CERVICAL REGION.

The great vessels in the cervical region are subject to numerous deviations, many of which would materially interfere with the practice of certain operations in this part of the body. The latter only will be noticed in the following remarks. The common carotid artery usually divides into internal and external branches, near the superior edge of the thyroid cartilage, but the bifurcation may take place much higher up, near the base of the cranium. In other cases it divides as low down as the sixth cervical vertebra, and then two large vessels, of nearly equal size, are found ascending in the ordinary course of the common carotid artery.

The thyroid arteries present numerous deviations, both in origin and course. The superior thyroid arteries are occasionally much enlarged, in consequence of the inferior thyroidal vessels being absent; the artery, again, may arise, much lower down than it usually does, from the trunk of the primary carotid. Zagorsky relates an example of the former occurrence, where the superior thyroid on the right side was nearly as large as the external carotid. In a case which is recorded in the Memoirs of the Russian Academy of Sciences, the superior thyroid arose about an inch below the bifurcation of the carotids; it was nearly twice its ordinary calibre, and as it ascended close upon the common carotid trunk, might easily have been included with the latter in a ligature. The branches distributed to the thyroid gland were very large and superficial, being merely covered by the skin and platysma myodes. This latter circumstance, as M. Robert justly remarks, should render the surgeon cautious in opening all abscesses situate in the upper and anterior region of the neck.

The origin and course of the different branches of the inferior thyroid artery are extremely various. Burns describes the two inferior thyroid arteries as arising by a common trunk from the subclavian or arch of the aorta, and ascending in front of the trachea to the thyroid gland. Manec has seen this common trunk given off by the left subclavian. In other cases the vessels, which are usually branches of the thyroid artery, arise separately from the subclavian artery, or innominata. In a good example of this distribution, which is preserved in the museum of Guy's Hospital, the left inferior thyroid was a branch of the innominata, and crossed obliquely over the front of the trachea to gain the left lobe of the gland. Besides the inferior thyroid artery there exists very frequently a vessel described by Neubauer under the name of thyroidea ima, and by Harrison under that of t. media. It usually arises from the arch between the innominata and left carotid, and ascends straight on the trachea to the thyroid body. It may, however, be furnished by the innominata or primary carotid. In a case detailed by Burns, this anomalous branch was larger than a crow's quill, and ascended between the sterno-thyroid muscles to the lower border of the thyroid gland at the left side; it was accidentally wounded during the operation of œsophagatomy, and gave rise to a serious hæmorrhage.

It is scarcely necessary to point out the influence which the deviations just described must necessarily exercise on all operations performed in this region of the neck.

The anomalies of the great vessels which arise from the arch of the aorta are now familiar to most anatomists. They amount, in the aggregate, to nearly forty different modes of origin, but we have only to consider those which may concern the surgeon in the practice of his art.

The right subclavian artery, instead of being a branch of the innominata, may arise from any portion of the arch of the aorta, even as low down as the descending arch, an example of which the writer once met with in the dissecting room of Trinity College, Dublin. In such case the right subclavian may cross the front of the trachea obliquely towards the right side at any point between the sternum and lower border of the thyroid gland. Thus Burns relates a case, in which the vessel passed in front of the trachea immediately beneath the lower edge of the gland; and Walter has recorded an unfortunate operation of tracheatomy performed on the daughter of a celebrated professor of surgery, where the child died under the hands of the surgeon, in all probability from a wound of the subclavian or other great vessel which pursued the anomalous course just described. In other cases, the right subclavian artery passes between the trachea and œsophagus, instead of crossing the former in front, or it may rest on the bodies of the vertebræ, being covered by the trachea and œsophagus. In either of the cases now mentioned, an alteration in the calibre of the vessel may act as an impediment to deglutition, or the artery may be wounded by a foreign body in the œsophagus. Mr. Kirby has related a very remarkable instance of the latter, in the Dublin Hospital Reports. A woman swallowed accidentally with her food a fish-bone. She was soon seized with symptoms of suffocation, &c. Tracheatomy was performed, but the patient died of hæmorrhage which seemed to proceed from the œsophagus. On examination after death it was found that the right subclavian artery, which passed from the arch towards the right side, between the œsophagus and vertebræ, had been perforated by the foreign body.

In some cases, which the continental anatomists describe as not being of very rare occurrence, the left carotid artery is a branch of the innominata, and crosses immediately in front of the trachea, below the thyroid body to the left side of the neck. In one example which we met in the dissecting-room of Trinity College, Dublin, all the great vessels arose from the left side of the arch. The right carotid was the first branch, and crossed the lower part of the trachea, giving off the right vertebral artery as it passed. The left carotid and subclavian arteries were detached, nearly from the same point, to the left of the right carotid, while the right subclavian was given off from the descending arch, and passed to the right side behind the œsophagus and trachea. Finally, we may observe that in a very few rare cases the subclavian artery passes in front of the scalenus anticus muscle, the vein behind it; the relative positions of the two vessels being thus reversed [1], and that after it has emerged from beneath the scalenus muscle, the subclavian is sometimes completely enveloped by the axillary plexus of nerves, a circumstance which would greatly increase the difficulty of tying the vessel.

The vertebral artery (particularly the left) may arise from the arch of the aorta and ascend along the neck for a considerable way before it enters the foramina of the cervical vertebræ. We have seen it enter as high up as the fourth, and we have Sœmmerring's authority for stating that it may enter the second cervical vertebra. In such a case the vertebral artery might be mistaken for the primary carotid, or included in the same ligature with the latter vessel. Such disposition would, also, increase the danger of all incised wounds of the neck, &c. Burns has related an instructive case of this kind. The left vertebral artery arose from the arch; the right was given off by the subclavian, and ascended immediately behind the carotid artery and on the rectus anticus muscle, as far as the foramen of the third cervical vertebra, through which it entered. Sometimes the trunk of the vertebral artery is formed by the union of two branches from the subclavian, or from the subclavian and arch, or we may have three distinct branches uniting to form the vertebral, an example of which is related in Meckel's Archives.

The disposition of the vertebral artery to which allusion has just been made, and its course along the neck, only separated from the common carotid by a thin slip of fascia, might, as A. Burns remarks, render it a matter of some difficulty to distinguish an aneurism of the vertebral from one of the primary carotid artery, but the surgeon, acquainted with the varieties of the arterial system, would immediately detect the source of error by alternately compressing either vessel, and observing the effect produced on the aneurismal tumour.

The arteries of the upper extremity present a great variety of anomalies, which are interesting to the surgeon. Passing over those of the circumflex arteries, and arriving immediately at the brachial, we find that this vessel, instead of dividing into two branches at the bend of the elbow, may bifurcate at any point between the elbow and the axilla. This high bifurcation of the brachial artery occurs very frequently, and is much more common than any other anomaly to which the vessel is subject. It may take place just above the bend of the elbow, in the middle of the arm, or so high up in the axilla as to furnish, from the radial branch, the long thoracic artery. The manner in which the division into two branches takes place, also, varies much. Sometimes both are of equal size, run down close to each other along the inner edge of the biceps, and separate near the elbow-joint to become radial and ulnar arteries. In many other cases, the branches are of very unequal size; one is nearly as large as the brachial in its ordinary state, and follows the usual course of that vessel; the other, which proves to be radial, is small, is detached from the side or front of the main trunk, and usually runs for some way along its inner side, before it passes over to the radial side of the arm. In other cases, the radial arises from the inner side of the brachial near the upper third of the humerus, and immediately winds over the trunk to gain the other side. In the cases now described, of all of which the writer has seen numerous examples, the radial artery is usually covered by the tendinous fascia of the upper arm, but in a very few instances it pierces the brachial aponeurosis and becomes superficial. In high bifurcations of the brachial artery, the radial is sometimes joined to the ulnar at the bend of the arm, by a transverse branch of considerable magnitude, which furnishes the radial recurrent. Two very remarkable examples of this distribution are represented in the writer's work on the varieties of arteries. Tiedemann has also represented this anomaly. In one subject which we saw at Clamar, in 1834, the transverse communicating branch joined the ulnar and radial arteries at the lower third of the fore-arm. It may be remarked, that the transverse communication just described, which exists as the normal distribution between the arteries of the corpus callosum, has been found between the vertebrals, just before they form the basilar; between the primary iliacs, near the bifurcation of the aorta, and between the posterior tibial and fibular arteries, at the lower third of the leg.

Near the lower third of the fore-arm the radial artery sometimes turns round the radius, descending along the posterior surface of the bone to the interval between the first and second metacarpal bones. In cases of this kind no pulse can be felt at the wrist, and if the surgeon were to cut down between the flexor carpi radialis and supinator longus muscles, he would find a comparatively insignificant branch (superficialis volæ) instead of the principal artery. Mr. P. Bennet Lucas has described an example of this kind which fell under his notice at the North London School of Medicine. "The radial immediately after its origin sent off the superficialis volæ, which was very delicate, and occupied the position of the radial artery. The radial trunk itself ran very superficially, and at the junction of the middle and inferior thirds of the fore-arm, turned round the edge of the radius to the space between the metacarpal bones of the thumb and index finger."

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[1] M. Blandin has given the particulars of a case in which the subclavian vein passed with the artery *behind* the scalenus anticus muscle. Here the surgeon might have included both vessels in the same ligature.

THE ULNAR ARTERY.

The ulnar artery is much less liable to present anomalies in its origin or course than the radial. When the ulnar arises above the bend of the elbow it is usually given off from the upper part of the brachial artery or even from the axillary, and, according to Burns's authority, which however is at variance with our own experience, it commonly descends along the inner side of the arm, and *above* the fascia to the palm of the hand. In such a case as this the artery might readily be wounded by a careless operator during venesection, and it seems probable that in most instances where the artery has been injured, an anomaly existed similar to the one just described. In some rare cases, the ulnar artery, even when it arises at the bend of the arm, penetrates the fascia, and accompanies the basilic vein to the wrist, or as happened in a case described in the Archives Gén. (March 1824), it passes superficially for the upper third of its course, and then dips under the fascia and palmaris longus muscle. Anomalies of the interosseous artery are still rarer than those of the radial or ulnar artery. Sometimes the interosseous artery is detached from the upper part of the humeral and descends with it to the bend of the arm, in which case it might be mistaken for the radial or ulnar arteries. Sometimes the brachial subdivides, high up, into three branches of nearly equal size, which eventually prove to be radial, ulnar, and interosseous arteries. In two very remarkable cases, which the writer examined in Trinity College, Dublin, the interosseous terminated by anastomosing with the radial near the wrist-joint.

The preceding are the chief anomalies affecting the vessels of the upper extremity, which are of any importance in a surgical point of view. One or two more, however, remain for enumeration. The axillary artery sometimes divides into two branches, of equal size, which run down close to one another beneath the edge of the biceps, and unite near the fold of the arm. We have seen two examples of this disposition, which has also been found in the femoral and basilar arteries.

The vasa aberrantia are supernumerary vessels, sometimes of considerable magnitude, which arise from the subscapular, axillary, or brachial arteries, and terminate in the ulnar or (most commonly) radial. Cruveilhier has observed, that in many cases of this kind the brachial artery is situate at a greater depth than it usually is, and the vas aberrans runs either over the main trunk, or immediately beneath the brachial aponeurosis. Finally we have to direct attention to the occasional and not very rare existence of a median artery. This branch arises from some one of the arteries of the fore-arm, descends between the flexor sublimis and profundus, in company with the median nerve, and terminates in a great variety of ways in the palmar arch. In some instances which we have seen, this median artery was of very considerable magnitude.

REGION OF THE ABDOMEN.

The only arteries in this region, with the varieties of which the surgeon is concerned, are the epigastric and obturator arteries.

The epigastric has been sometimes wounded during the operation of paracentesis abdominis, but more frequently this accident is occasioned by the presence of some anomalous branch, or by some deviation from the usual course of the renal. Ramsay has recorded an illustrative case; the circumflexa ilii, which arose below Poupart's ligament, divided into two branches; one pursued the ordinary course of the circumflex: the other ascended between the abdominal muscles, in a line midway between the linea alba and the superior anterior spine of the ilium; this branch was accidentally opened during the operation of paracentesis, and gave rise to fatal hæmorrhage. An analogous case is related in Kleinert's Repertorium, November 1835, where the wounding of an anomalous branch of the epigastric was likewise attended with fatal consequences. But varieties of the epigastric and obturator arteries are infinitely more interesting on account of their relation to the various operative methods which have been proposed for the relief of strangulated hernia. Under ordinary circumstances the operation is not attended with much difficulty, but unfortunately both the epigastric and obturator arteries are so liable to deviate from their usual disposition, that the surgeon is embarrassed and perplexed by the multiplied irregularities which they present.

Thus, as M. Verpillat remarks, the epigastric artery, which usually arises at the level of Poupart's ligament, may be given off either *above* or *below* the femoral ring, within a space of three or four inches. In the first case, the artery might be pushed on the inner side of the hernial sac, and in the second it would necessarily be wounded in dividing the stricture from within outwards. In one very remarkable case which we have seen, the epigastric was given off by the profunda femoris below Poupart's ligament, and would have lain completely in front of the sac, in a case of femoral hernia. Gunz relates a case in which the epigastric lay so close on the upper part of the sac that it must have been wounded if the surgeon cut directly upwards, and he mentions two instances in which this mode of operating was followed by fatal hæmorrhage from a wound of the epigastric artery. Dupuytren endeavoured to avoid this accident by cutting that portion of the fascia lata which is attached to, and renders tense the crural arch, and, if we are to believe M. M. Roche and Sanson, never wounded the epigastric. But on the other hand the late Dr. A. Thomson, who for many years devoted himself exclusively to the anatomy of hernia, has assured us that he had positive proofs that Dupuytren wounded the epigastric artery on three several occasions, and M. Verpillat, the author of a well-written paper on femoral hernia, was informed by M. Robert, that he had examined the bodies of two persons who died from hæmorrhage under similar circumstances.

The obturator artery is as liable to irregularities of origin as any other in the body. The most common form is that in which it arises by a common trunk with the internal epigastric. According to Cloquet's experience, with which our own observations fully coincide, this occurs once in three times; according to Hesselbach even more frequently, or three times out of five. When the obturator arises from a trunk common to it and the epigastric, it may detach itself from the latter vessel either above, below, or to the outer side of the femoral ring.

In the last of the three cases just mentioned, the obturator crosses the external margin of the ring, and is liable to be wounded if the operator cut obliquely upwards and outwards. In the first case, it winds along the edge of Gimbernat's ligament, to which it approximates more or less closely, according to the length of the common trunk. Finally, when the obturator separates from the epigastric below the femoral ring, it is situate quite close to this latter, and sometimes passes through it to gain the edge of the pubis. These different varieties of origin and disposition are so multiplied and combined as frequently to lead to fatal accidents during the operation for strangulated hernia, even when performed by the most skilful and experienced hands. If, as some surgeons recommend, we divide Gimbernat's ligament freely, we incur a very great risk of wounding the obturator artery. Scarpa is of opinion that this occurred in the case related by Mr. Hey. A similar accident happened to Mursinna; the femoral ring was completely surrounded by an arterial circle; on the inner side lay the obturator; on the outer the epigastric, and both vessels crossed immediately in front of the tumour above. Although the fibrous coat of the obturator had been merely grazed by the knife, hæmorrhage supervened on the eighth day and carried off the patient. M. Breschet relates an analogous case, in which the occurrence of a similar accident was prevented by the caution of the operator, who divided Gimbernat's ligament to the extent merely of two lines. On reducing the hernia, and passing up the index finger, the pulsations of an artery were distinctly felt on either side of the ring. The patient died, and on examination it was found that the obturator artery lay on the inner side of the neck of the sac, and would have been divided had the incision been carried one or two lines further. The epigastric artery ran along the outer side of the sac, but was distant from it four or five lines; while the spermatic and supra-pubic arteries lay so much in front, that they would have been wounded by carrying the incision directly upwards.

The obturator artery, as we have already said, occasionally arises below Poupart's ligament, from the femoral. A good example of this kind was preserved in the Museum of Guy's Hospital. In such cases the obturator commonly ascends close on the pectineus muscle, and internal to the femoral vein, and consequently would be found behind the sac in femoral hernia, but we have seen two examples in which the vessel advanced so far forwards, and left beneath it such a space that a femoral hernia must have passed immediately behind it.

As in the operation for strangulated hernia, so also in that of lithotomy, do anomalies of the arterial system frequently give rise to fatal accidents.

"Hæmorrhage," says Boyer, "is one of the commonest accidents which occur during lithotomy. The blame is often thrown on the operator, or on the method of operation, which he may have adopted; but in most cases, unjustly, for the perineal arteries present such a multitude of varieties both in situation and course, that the most skilful surgeon can never be sure of avoiding them, no matter what mode of operation he may adopt."

The pudic artery, in its third stage, instead of lying close on the rami of the ischium and pubis, may approximate more or less to the median line of the perineum. Deschamps accuses Desault of having wounded the pudic in this stage, and adds, "that he has frequently seen arterial blood spout, at the first incision, from this vessel, or from some of its branches."

In some cases the superficial artery of the perineum presents the same anomaly as the pudic, and the same accidents result from its lesion. The dorsal artery of the penis, as was first observed by Winslow, and since by Burns, Monro, Meckel, and several other anatomists, sometimes arises from the obturator or some branch of the hypogastric, and having passed along the side of the bladder, penetrates the upper part of the prostate gland to gain the dorsum of the penis. In some cases, instead of penetrating the prostate, it runs along the side of the gland, and is then even more exposed to injury during the lateral operation. An anomaly of this kind was the cause of an unfortunate accident which occurred in the practice of the late Mr. Shaw.

The transverse artery of the perineum is sometimes double, and in a case described by M. Belmas, it arose from the internal pudic just below the lesser sciatic ligament, and passed over the bulb across the lines of the lateral and bi-lateral incisions.

LOWER EXTREMITY.

Anomalies of the arteries of the lower extremity are much less frequent in occurrence and less perplexing to the surgeon than those of any other region. The point at which the common femoral divides into deep and superficial femoral arteries is very uncertain. The profunda femoris usually arises from an inch and a half to two inches below Poupart's ligament, but Berard mentions a case, in which it was given off as low down as the middle of the thigh. In other cases it arises from the external iliac, one or two inches above the crural arch.

Sir Charles Bell operated for popliteal aneurism without success; on examining the body after death, it was found that the femoral artery divided immediately below the origin of the profunda, into two branches, which afterwards reunited in the tendinous canal of the triceps. The preparation of a similar variety is preserved in the Museum of the Dublin College of Surgeons. Sandifort mentions a case in which the femoral artery divided into posterior tibial and fibular immediately below Poupart's ligament. Ramsay met with an example of this division just above the edge of the popliteus muscle, and Portal saw the femoral continue its course as far as the middle of the leg before it divided into tibial and fibular arteries. Zagorsky has related a very remarkable case, in which the femoral gave off a superficial branch which descended along the course of the saphena vein to join the internal plantar. This branch, then, may be considered to be analogous to the median artery of the upper extremity. The remaining varieties of the arteries of the lower extremity merely require to be enumerated. The anterior tibial sometimes terminates on the back of the leg, its branches being supplied by the posterior tibial. Pelletan describes a case in which the anterior tibial ran immediately underneath the skin to the ancle. The posterior tibial may sometimes be wanting altogether. In one very curious case, which occurred in the dissecting-room of Trinity College, there were two posterior tibial arteries.

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(P. Hennis Green.)

ARTERIOTOMY (τομή, 'a section.') The operation of opening an artery (in general the temporal) in order to abstract blood. See Bleeding.

ARTHRITIS, TRAUMATIC.—According to the definition commonly received among surgeons, the wound of a joint consists in the opening of the synovial capsule. A theoretic objection might be raised to this definition, on the ground that it includes only wounds of the more complex articulations, but for practical purposes it may safely be adopted, since the wounds of fibro-cartilaginous joints, such as those of the vertebral bodies and pelvic bones are of extremely rare occurrence, and are unattended by peculiar symptoms. It will, therefore, be understood that this article is devoted to the consideration of wounds of those complex organs which are composed of bones, encrusted with a layer of cartilage, held together by ligaments, and having interposed between their cartilaginous surfaces a cavity lined on all sides by a highly organized synovial membrane.

Traumatic arthritis was rendered familiar to the earliest surgeons by the accidents of military life. The progress of knowledge has given us increased power of preventing its appearance, and of obviating its disastrous consequences, but it still remains one of the most alarming maladies to which our attention is directed. The synovial membranes, like the serous, to which they have a strong affinity, rapidly propagate the inflammation set up at a small point of their surface, so that the whole is soon involved. Nor is this all; the law of disease, by the operation of which tissues become affected by the lesions of contiguous structures, is no where more observable than in articulations. If the acute synovitis which frequently succeeds to a simple wound of a joint, be not checked, and a suppurative action be set up, the bone, ligament, and cartilage ere long participate, and the organ falls into hopeless disorganization.

Attempts have been made by writers on surgery to specify the classes of articulations most liable to wounds, and it has been generally agreed that the ginglymoid joints are more exposed than any other. It is no doubt true that joints of this class are less protected by soft parts than the enarthrodial, but there are other circumstances to be taken into consideration. The ginglymoid joints are more or less protected by bony processes, such as the olecranon and coronoid process in the elbow-joint, and the patella in the knee-joint, which are placed at the points most exposed to the penetration of foreign bodies, or least covered by muscle and tendon. The situation of a joint must also exercise an important influence. Thus in close combat, whether both parties be on foot or on horseback, the shoulder will be more exposed than any other articulation, and in charges made by cavalry or infantry, the knees of the former, and the shoulders of the latter will be chiefly liable to wounds. In point of fact, the records of military surgery show that wounds by cutting and piercing instruments are sustained by the shoulder more frequently than by any other joint. The liability to gunshot wounds is tolerably equal in all, since, in the large majority of cases, the force of projectiles is such as to overcome any resistance which soft parts can offer.

Writers on surgery, in treating of wounds of joints, have commonly founded the distinctions drawn between different wounds, on the various forms of the instruments producing them. There are certain advantages attending this arrangement, but it must not be forgotten, that precisely the same train of symptoms may, and frequently does follow wounds of very different form and extent. A more scientific and comprehensive classification may be made by a reference to the tissue or tissues involved in the wound, and the variations induced by the shape and size of the body inflicting the wound may be adequately noticed as varieties rather than as classes. Proceeding on this basis, the wounds of joints may be arranged under two general heads:—

1. *Simple wounds*,— comprising lesions of synovial membrane only.

2. *Complicated wounds*; including,—

   a. Wounds complicated with injury of ligaments and cartilage.

   b. Wounds complicated with injury of articular bone.

To these two complications a third important one might be added, in the shape of luxation, but this lesion will be considered with more propriety under the head of compound luxation. (See Luxation.)

1. *Simple wounds.*—The synovial membrane can never be the only articular tissue wounded in such joints as the shoulder and hip, which are completely enveloped by a capsular ligament, nor even in the ginglymoid articulations, unless the wound be inflicted by a narrow piercing instrument. The division of ligamentous fibre being, however attended with no active or immediate inflammation, may be passed over in silence while we are considering the phenomena developed by the injured synovial membrane.

The synovial membrane may be punctured by a piercing instrument, as a nail or the point of a bayonet,—may be freely divided, as by a knife or sabre,—may be penetrated with contusion, as by a shot and small bullets, or may be lacerated, as in compound dislocations. The only consequence, so far as the synovial membrane is concerned, to be apprehended from these different forms of injury, is inflammation, and the main difference between them arises from the greater or less proneness to this result. As a general rule, it may be laid down, that the degrees of exposure of the articular cavity and of serious consequences are in relation to one another; but it is a rule to which the case-book of every surgeon will present exceptions.

The diagnosis of simple wounds of the joints is sufficiently easy where the wound inflicted has widely exposed the articular cavity, but is of greater difficulty where a narrow piercing instrument has been employed. In this latter case we must form our opinion from the situation of the external opening, and its form and size compared with that of the instrument used, the course which the wound has taken, and the depth to which it is stated to have extended. In some cases, a flow of synovia from the puncture removes all doubts; but there is a source of fallacy connected with this symptom, which must not be lost sight of, since the synovia may have exuded from a bursa, or the wounded theca of a tendon. Nor must it be concluded, from the absence of a synovial flow, that the integrity of the joint is preserved, since the exit of the secretion may have been prevented by a change of the relation between the wound of the synovial capsule and that of the integuments, or by an effusion into the narrow canal formed by the passage of the instrument through the soft parts. Fortunately, an exact knowledge of the extent of the wound is not of sufficient importance to justify the introduction of a probe, which would indeed frequently afford no certain indication, while at all times it must produce irritation, expose to the danger that arises from the admission of air, and break up adhesions that may have already formed. The surgeon in these cases may borrow from politicians the principle of non-intervention. When the wound is extensive it may be readily recognized to have penetrated the joint by the flow, often copious, of synovia, which immediately takes place, and which may be readily reproduced, (though extreme gentleness ought always to be observed) by gently moving or pressing the articulation. At times all possibility of doubt will be removed by the exposure of the white and glistening surfaces of the articular cartilages.

After the infliction of a wound of the synovial membrane, it sometimes, and under wise management, not very rarely happens, especially if the wound be slight and air have not been admitted, that no alarming symptoms follow, and the parts divided heal rapidly by the first intention. This may even happen where the division has been very extensive. Thus Boyer[1] relates a case in which he saw the wrist joint completely laid open from its posterior surface; the ulna and radius projecting from the wound; the extensor tendons completely divided, and the hand pendulous by the soft parts situated anteriorly. He immediately reunited the edges of the wound, and at the end of fifteen days, it had completely healed. More commonly, however, where the patient is vascular and plethoric, where his constitution has been originally bad, or has been impaired by excess or disease; where injudicious scrutiny has been made of the wound; where absolute rest is not given to the limb, and even sometimes where none of these sources of evil are present, an acute inflammation commences. For twenty or thirty hours after the infliction of the wound, the patient seems comparatively easy and the accident appears trivial; but at the end of that period, there is felt in the joint a dull aching pain, which Begin[1] states to precede invariably according to his experience, all other symptoms. This pain, at first dull and intermitting, gradually increases in severity, till it becomes acute and constant, and is aggravated by the slightest motion; the articulation swells by effusion within its capsule; the surrounding cellular tissue becomes infiltrated, and the skin covering it is hence hot and shining, but not red; the lips of the wound are pale and thin, and throw out a purulent serum; œdema affects the limb below the injured joint, and an erythematous blush sometimes extends upwards towards the trunk[2]. The constitution now takes the alarm, and fever lights up: the respiration is hurried; the pulse hard; the tongue white, the surface hot and flushed; the countenance anxious; the thirst extreme: delirium sometimes supervenes; there is incessant watchfulness; subsultus comes on; and the patient, if of feeble habit, may be carried off in four or five days after the accident. Occasionally, the inflammatory symptoms are less severe, and are almost entirely local; but in general, the arthritis consequent upon a wound is of very acute character. The combined effect of the distension of the synovial capsule and of the surrounding infiltration, sometimes produces such pressure on the adjacent vessels that the limb below the injured joint falls into a state of gangrene.

This acute state of inflammation may have several terminations. Where the treatment is vigorous, and the previous health and habits of the patient have been good, the constitutional disturbance may subside with scarcely less rapidity than it supervened; the acute pain is mitigated; the swelling diminishes; and, with care, the limb is restored to its free and healthy action. In other cases, the febrile state passes off, and the local inflammation subsides, but does not altogether disappear; the joint continues slightly swollen; and a chronic synovitis is established, varying in its degree of intensity, but always imparting a certain debility to the limb, and liable to assume a more active form, or to induce disease of the adjacent tissues. The arthritis becomes chronic almost invariably in those who make premature use of the joint. During exercise the pain is scarcely perceived, but when rest is again given, a pricking pain, accompanied by a sense of weakness, is felt, and a moderate swelling displays itself where the structures around the joint are most distensible.

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[1] Traité des Maladies Chirurg.—Vide Plaies des Articulations.

[1] Dictionnaire de Médecine et Chirurgie Pratique. tom. iii. art. Arthrite Traumatique.

[2] Thomson states this to be a common symptom after gunshot wounds of joints. Vide Report of Observations made in British Military Hospitals in Belgium.

A third termination of acute arthritis occasionally, though rarely exemplified, is the effusion of a plastic false membrane, which contracts adhesions to the free synovial surfaces, and establishes a soft anchylosis more or less complete. The observations of several surgeons show that this is a possible result of active inflammation; but it would be incorrect to suppose it one of ordinary occurrence, since the synovial membranes, though allied in many respects to the serous, have a strong resemblance to the mucous, in their indisposition to form bands of adhesion. The reason may probably be the same in both, that the presence of the natural secretion prevents the effused lymph from becoming organized and adherent. In a fourth class of cases, the acute inflammation continues with unabated intensity, and a suppurative action is established. Here all the constitutional disturbance already noticed is displayed with extraordinary vehemence. There are severe rigors ; the tongue becomes brown, dry, and harsh ; the stomach rejects its contents ; all the secretions are deranged ; there is general mal-aise ; great anxiety, or even marked delirium ; the articulation becomes filled to distension with purulent matter, if the original wound has closed; and the tissues external to the joint rapidly take on an inflammatory action. The synovial membrane now ulcerates if there be no communication with the external wound, and the matter makes its way to the surface by long, winding sinuses. Even under this state of things the disease may be confined to the synovial membrane, and if the purulent matter have a sufficiently free exit, and the case proceed favourably, the suppuration will gradually diminish, the forces of the patient will rally, and he is ultimately restored to health with a joint but slightly stiffened. Thus Warner[1] relates a case of hydrops articuli, in which he made an opening into the joint, which was followed by suppuration. For the discharge of the pus the joint was opened a second and a third time, yet the patient, though placed in imminent danger, and very nearly sinking, ultimately recovered with little stiffness of the joint. The second case related by Hey, in his paper on wounds of the joints,[2] presents similar features (except that the wound was not inflicted by the surgeon), and had a similar termination. In other cases, granulations spring from the synovial membrane as the suppurative action diminishes, and the inosculation of these effects a cure by the establishment of soft ankylosis. These are the most favourable terminations of the formation of abscess in the synovial membrane, and our treatment ought ever to be influenced by the hope of obtaining them. More commonly, it happens that the disease is propagated to the other articular tissues, and a train of symptoms is developed precisely corresponding to those which are commonly witnessed in idiopathic disease, but more rapid in their progress. The cartilage in these cases is very early affected, and an ulceration commences on its free surface, which rapidly extends to the bone, and the osseous tissue having once become diseased, the mischief is perpetuated until amputation or death closes the scene.

Such being the symptoms, progress, and termination of wounds of the synovial membrane, it now remains to inquire what are the morbid appearances presented on an examination of the joints affected in the various stages depicted. The first effect of inflammation in a synovial membrane is probably, as in the mucous membranes, a cessation or diminution of the natural secretion. This is a condition, however, only inferred to exist, since we have very rarely the opportunity of examining joints at a sufficiently early period. To this succeeds a dense injection of the synovial surface accompanied with some tumefaction, and an increased secretion, which in some cases is sanguinolent. The folds or reduplications of synovial membrane which hang into the cavity of the joint, like valvulæ conniventes, partake in the general injection, and the cellular tissue and pellets of fat which they contain becoming infiltrated, they acquire an inordinate development, and overlap the cartilaginous surfaces in such a manner as to have been mistaken for a new membrane. If the inflammation be not subdued, red vessels begin to shoot over the membrane covering the cartilage, commencing always from the circumference, and often proceeding towards the centre in a regular march, and with a defined outline, which is to be ascribed with great probability to the limitation produced by the pressure of the opposing articular surface. In some cases, the surface of the synovial membrane now becomes covered with a layer of plastic adhesive matter from which villous and vascular prolongations depend into the articular cavity, and by the union of which with one another, and with the cartilaginous surfaces, a species of soft ankylosis is established. More usually, these villous prolongations are either absent altogether, or do not form adhesions ; but the surface of the synovial membrane becomes dull, opaque, and traversed by brown or crimson patches, while its substance is thickened, and in some degree pulpy. If the inflammation pass into a chronic form, the joint continues slightly distended, with a serous or sero-albuminous fluid, and the synovial surface becomes granular, or even villous. If, on the other hand, a suppurative action be set up, the interior of the joint very commonly presents the appearance of an ordinary circumscribed abscess, and the joint becomes distended by purulent fluid, mixed with curdy or albuminous flakes, until at length ulceration occurs at different points in the synovial membrane, and the matter makes its way to the surface by fistulous tracks. Even under these circumstances, the lesion may still be confined to the synovial membranes, but in the immense majority of cases, the adjacent tissues share in the derangement. The ligaments become enlarged by a deposit of lymph in their articular tissue; lose their natural glistening appearance; and are gradually removed by ulceration. The cartilage is softened, and slightly tumid,—presents small fossæ on portions of its surface, extending to the bone; in other parts exhibits fibrous brush-like projections, which hang into the cavity of the joint, and, in the end, is entirely removed. This ulceration commonly commences at the circumference of the cartilage,—a phenomenon which is readily accounted for if the lesion be propagated as in many other cases by contiguity, since the portion of cartilage nearest to the inflamed synovial membrane must necessarily, in that case, be first affected. The bone becomes inflamed, and presents a softened highly vascular surface. In some cases, the inflammation is very much confined to the surface, and ends in the development of vascular granulations which ultimately prove the medium of ankylosis; but in other cases, the disease acquires a deeper seat and advances to a confirmed and obstinate caries. Occasionally, small spicula of bone are detached; and a cure may be effected by the removal, in this way, of the articular surfaces, but most commonly, amputation, or excision, are the only remedies.

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[1] Warner's Cases in Surgery.

[2] Hey's Practical Observations in Surgery. Ed. 3rd. Lond. 1814.

Around the joint are disposed masses of densely infiltrated cellular tissue, burrowing abscesses lined with granular lymph, and winding sinuses, the consequences of long-continued and deep-seated mischief. The morbid appearances of a wounded joint in the advanced stage of ulceration, correspond precisely to those produced by idiopathic disease. "Many of the phenomena," says Hennen, "presented by joints affected with white swelling are to be observed in some of the more protracted cases of gunshot injuries, and particularly a great diminution of their specific gravity."

The treatment of wounds of the synovial membrane will of course vary according to the period at which the surgeon is summoned after the infliction of the injury, and the varying phenomena which the progress of the case may present. The first indication after the reception of a wound is to procure immediate reunion. A meddlesome surgery is bad in these cases not less than in many others, and the surgeon ought not to be curious to ascertain the exact extent of the wound or the ease with which a probe can be passed into the articular cavity. If, however, there be a strong probability of the presence of a foreign body within the joint, a careful examination with the view of removing it is justifiable. In the majority of cases, however, this complication is not to be apprehended, and the wound may be treated as a simple incised wound, by the application of straps of adhesive plaster or of lint dipped in the blood flowing from the wound, and maintained in its position in the ordinary way. The next indication is to preserve perfect repose, and for this purpose it is advisable to apply a splint with bandages above and below the joint, as the patient, not at first suffering much from pain, almost unconsciously makes use of the limb. In addition to these means, it is usual to employ warm or cold applications, but with more than doubtful utility, since the fluid must tend to prevent the close adhesion of the dressings, and can scarcely be otherwise than prejudicial to the raw surface of the wound. If the constitution of the patient be such as to threaten the access of inflammation, antiphlogistic measures may be adopted with the view of prevention. In all cases, the diet ought to be low, the skin to be kept open, and the bowels in good order, though not purged. No error is more common than that of administering drastic and irritating purgatives, even when there is no reason to suppose that the intestines are much loaded. Of course, there should be regular evacuations, but the necessity of frequently relieving the bowels creates an unavoidable motion of the joint, than which nothing can be more prejudicial to its restoration. If these simple measures be adopted, it not unfrequently happens that no alarming symptoms are developed, even when the articular cavity has been very widely exposed, and the patient is restored, without accident, to the perfect use of the limb. Sir Astley Cooper[1] relates cases in which compound dislocations of the ankle being thus treated were healed with extraordinary rapidity. Hey[2] relates the history of several wounds of joints in which the articulation was so exposed that he could pass his finger into it, which nevertheless recovered without accident; and Boyer[3], from whom we have already cited a similar narration, furnishes other examples.

"Many cases of wounds of the knee-joint," says Guthrie[4], "in which the capsular ligament is wounded, and the articulation opened without injury to the bones, do as well as simple incised wounds made with a clean-cutting instrument suddenly withdrawn after inflicting the wound." If, however, this desirable result should not follow, and inflammation commence, our measures ought to be taken early and with vigour. Blood-letting to a considerable amount ought to be made use of both generally and locally, the tartarized antimony should be administered in nauseating doses, or should be combined with calomel and opium, and every measure taken to moderate the fever that must ensue. As to diet, and the preservation of rest, precisely the same rules ought to be observed as before the accession of the inflammatory symptoms, but advantage will now be derived from the employment of a lotion around the joint, which may be used warm or cold according to the feelings of the patient himself. The common prejudice is in favour of cold applications, but I have seen very great advantages result from the combined effect of warmth and moisture. This treatment must be actively followed in proportion to the size of the joint involved, and the constitution of the person who has undergone the injury. If by these means the action should be reduced to a chronic form, the remedies commonly employed in chronic synovitis of idiopathic origin may then be employed. If, on the other hand, the acute inflammation should be followed by suppuration, our line of treatment must undergo a great alteration. The fear of forming an opening into the joint must now be abandoned, and as soon as the joint becomes distended with pus, if the original wound have closed or be of inconsiderable size, not allowing exit to the pent up fluid, a sufficiently free incision must be practised. Petit recommended that the opening should be of large size, while David, on the contrary, was in the habit of employing a trocar. Boyer thinks that both these modes are worthy of adoption in different circumstances; the latter, where the collection of pus has formed as a consequence of caries of the bone; the former, where the suppuration has been induced by a wound; and, as the object is to relieve the excessive pain and distension which the collection of matter occasions, Boyer's decision deserves our adoption. The relief which follows the free evacuation of the matter is very surprising, but the pus continues to be secreted, and the opening, therefore, ought to be made in as depending a position as possible, that the fluid may find vent almost as rapidly as it forms. The posture of the limb ought also to be regulated with a view to the attainment of this object, perfect rest being still enjoined. Emollient and anodyne poultices may be applied around the joint; the diet must be generous, and tonics or anodynes may be given as circumstances render necessary. It is impossible to sketch accurately the treatment that will be applicable to the various conditions of these alarming cases, and a brief outline is all that can be given.

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[1] Sir A. Cooper on Dislocations and Fractures.

[2] Practical Observations in Surgery. Edition 3rd. London, 1814.

[3] Traité des Maladies Chirurgicales.

[4] Guthrie on Gun-shot Wounds.

In the last described termination of this disease,—that in which the adjacent articular tissues become affected, the treatment adopted so precisely corresponds to that advisable when the lesion has been idiopathic, that it is unnecessary to enter upon its consideration. As a general rule, it may be laid down, with only too much truth, that in the present state of surgery, the most favourable terminations of this latter state to which we can look forward with any degree of confidence, are, in the lower extremities amputation; and in the upper excision.

2.—*Complicated wounds of joints.*—Of the complicated wounds, we have first to consider:—

a. Wounds complicated with injury of ligament and cartilage.

Lesions of this sort will demand very little of our attention, since the symptoms additional to those of wounds of the synovial membrane are not very numerous or striking. We know that in the enarthrodial articulations the synovial capsule cannot be opened without a corresponding wound of the ligamentous capsule. In other articulations, we form our opinion from the extent and size of the wound; the direction which it has taken, and the abnormal mobility which exists between the two articulating extremities. A wound of the cartilage can rarely be ascertained unless the joint be laid widely open, when the diagnosis is too obvious to require explanation. In either case, the immediate symptoms induced by wounds of these tissues, are so slight and immaterial, as commonly to be absorbed in the phenomena produced by the injured synovial membrane. If the divided ligament be funicular, the ends retract, and the interspace between them becomes filled up by newly-developed cellular tissue, which forms the bond of reunion, and ultimately acquires a ligamentous character. This process probably occupies some time, but in capsular ligaments, where the wound is made parallel with the fibres, the reunion, though still effected by cellular tissue, takes place very rapidly. Thus, after dislocation of the humerus, where the capsular ligament must be extensively ruptured, we often find the patient in the course of a week or two enjoying perfect motion of the arm. In unhealthy constitutions the reparative action now described is not set up, but the ligament becomes swollen by deposit in its reticular tissue, and ulceration ensues, attended by all the symptoms and appearances described in the former part of this paper.

Wounds of cartilage, though certainly unproductive of striking alterations, are not so barren of consequences as Lobstein, Velpeau, and Cruveilhier have represented. There is such a paucity of facts concerning the pathology of cartilage, that we have no right to assert the impossibility of an immediate reunion of divided cartilaginous surfaces. I incised the cartilage of the femur in the tibiofemoral articulation of a dog. The incision was so distinct, that I heard the cartilages "cry" under the bistoury, and the edge of the instrument grated on the bone. The dog was killed at the end of two days, and on examining the joint I was unable to discover any solution of continuity on the surface of the cartilage. The synovial membrane covering the cartilage was every where smooth and natural. Usually, however, it is found that for a considerable time, sometimes even weeks, after the division of articular cartilage, not the slightest reparative or morbid toil is exhibited. Subsequently, the divided surfaces are found rather widely separated; the sharp edges are rounded off, and a fine flocculent tissue of false membrane fills up the cavity made by the incision. There are no facts on record to show that this false membrane ultimately becomes converted into cartilage, but Beclard asserts, very positively, that this tissue may be reproduced[1]; and the frequency with which cartilage is found among the adventitious analogue deposits may incline us to adopt his opinion. Where, in disarticulations, the cartilage is purposely scored or scraped, the flaps adhering to the cartilaginous surfaces of the stump heal by the first intention, but if suppuration comes on, the cartilage ulcerates and gradually becomes detached in flakes. It is extremely probable that another consequence of the wounds of cartilage may be ulceration, almost the only form in which chondritis displays itself. After an arthritis following a severe wound of the knee-joint, in which the patella had been completely divided by a bill-hook, and the cartilage of the femur wounded, I saw the cartilage of these two bones extensively destroyed and worm-eaten, by ulceration; but in this, and in all other similar cases, it must remain for the present an undetermined question, whether the ulceration is the effect of a morbid action induced in the cartilage by the wound, or whether it is owing, as in ordinary disease, to the propagation of inflammation from the synovial membrane.

The treatment of complicated wounds of joints of this class, must be in the first instance precisely similar to that already described as applicable to simple wounds. Where the cartilage is affected, it will be right to watch over the patient with increased care,—to enjoin upon him perfect rest for a longer time, and to treat with greater vigour any indications of debility and disease which the articulation may offer. When the ligaments have been divided, a very nice point will test the judgment and pathological knowledge of the surgeon. If too early motion be given, the intervening cellular tissue, which forms the bond of union between the divided ends of the ligament, will admit of great distension,—the ligament will in consequence pass into the condition termed diastasis, or, in other words, become relaxed, and the articulation will become weak, unstable, and constantly liable to sprain or luxation. It is by a knowledge of this fact, that Dr. Stromeyer has been successful in treating varus. The wounds of a fibro-cartilaginous structure, such as the tendo Achilles, heal like those of ligament. Availing himself of this fact, Stromeyer, in those cases of varus which depend on extreme contraction of the gastrocnemii muscles, has divided the tendo Achilles, and, by communicating motion to it at a very early period after the establishment of reunion, has succeeded in increasing the length of the tendon to such an extent that the patient has been restored to the natural use of the foot. If, on the other hand, the joint remain too long motionless, the ligament becomes stiff and unyielding, and long treatment is required to restore the proper flexibility. No certain rule can be laid down to guide the practitioner into the safe and middle path between these two evils; since differences of constitution, and the uncertain extents to which the divided ends of the ligament may be separated, occasion frequent variations. The best guide is to be found in the feelings of the patient. If, on permitting a little gentle exercise, the joint be found weak and unstable, perfect rest must be enjoined for some time longer. In all cases, the application of a bandage, or of a casing of adhesive strapping will be found advantageous, when the joint is about to be again exercised after division of one of its ligaments.

b. *Wounds of joints complicated with injury to articular bone.*—Wounds of joints, with this complication, are usually very severe; and although the assistance of the surgeon may frequently, and even generally be available to the preservation of life, the integrity of the limb can rarely be preserved. The large majority of these wounds are produced by projectiles, but there is no form of instrument which may not also produce them if great force be applied. I have seen the patella completely divided by a bill-hook; and in another case, the cancelli of the humerus laid bare, the elbow-joints widely exposed, the inner condyle broken off, and the cartilage torn away in flakes by the friction of a cart-wheel. The diagnosis of these wounds is in general easy, since the accompanying destruction of soft parts will usually admit of our examining the joint by the eye, or by the touch. The most difficult cases are those in which a ball, having entered by a narrow opening, has been turned aside from its direct course by meeting with the bone, and, having splintered the head of the bone, and lacerated the synovial capsule, has become imbedded. It would intrench on the province of others, to enter at large into the consideration of this and some corresponding phenomena, which will be treated of under the head of GUN-SHOT-WOUNDS. For the same reason, the reader is referred for the symptoms, progress, termination, and morbid appearances of the WOUNDS OF BONE, to the article under that head. The present paper is devoted, not to the description of these complications themselves, but of the effect which they produce upon the progress and treatment of a wounded joint. The remarks therefore on every feature of these wounds, except the treatment, will be exceedingly brief.

The progress of these cases may be divided into three stages. The injury, as we have already mentioned, is usually very severe, and the shock to the constitution consequently great. During the six, eight, or twelve first hours after the accident, the patient is either in a state of depression, or is so calm and tranquil, that an actual examination alone convinces the surgeon of the extent of the mischief. The exposed surfaces of bone and soft parts seem at this time to be benumbed, so that no pain is complained of, even on rough handling. The second stage commences by the ordinary symptoms of fever, thirst, restlessness, a hot skin, a full and accelerated pulse. The fever rapidly advances to a formidable height, the wound becomes exquisitely painful, and the progress of the case during this stage very much resembles that of a simple wound, as already depicted. In the third stage severe inflammatory symptoms have died away, but have left the patient feeble, and exhausted with a large suppurating wound—the cartilage ulcerating, the bone carious, and hectic commencing. This is the outline of ordinary cases, but extraordinary cases occasionally occur in which an admirably balanced constitution prevents the development of any alarming symptoms, and the injury inflicted is repaired with very trifling disturbance.

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[1] Beclard says, that in diarthrodial articulations the destruction of the cartilages is sometimes followed by their regeneration very nearly perfect, but the new cartilage, being thin, has a violet colour from its semi-transparency.—*Anatomie Générale.*

A favourable termination is not very common when the joint is left to itself, and constitutional treatment only adopted. The patient very often does not survive the second stage, but is destroyed by the intense fever which is then developed. Should this not happen, he usually lingers through a period of weeks, or even months, but at last dies exhausted by an incessant suppuration, which is maintained by diseased bone and ulcerating cartilages. There is, indeed, not an inconsiderable number of cases on record, in which this third stage has ended more happily. Thus Hunter[1] relates a case in which a ball entered the knee-joint at the outer side of the patella, traversed the knee-joint, and came out through the external condyle. Light dressings only were applied, and though severe inflammation came on, the patient recovered. Larrey[2], in his second Spanish campaign, tells of a Mameluke who received, besides other injuries, a sabre-cut in the left arm, which divided the skin, the olecranon, an articular portion of the humerus, the corresponding ligaments, and some branches of recurrent arteries. The wound was lightly dressed, and although some "grave accidents" were developed in the progress of the case, the patient recovered, and preserved some of the mobility of the joint. Sir A. Cooper[3] relates two cases in which persons recovered from compound fractures of the patella, followed by suppuration of the joint; and in the same work, Mr. Travers reports an example of compound fracture of the articular extremity of the femur extending into the knee-joint, from which, although the external condyle, with part of its articular surface, sloughed away, the patient recovered with a free use of the joint. These cases, however, form the exception, not the rule; and he who believes in the pithy axiom of Dionis, 'It is better to live with three limbs than to die with four,' will not allow them to guide his general practice. If he did, he would find, to use the phrase of Dupuytren, that he lost more lives than he saved limbs. The morbid appearances presented by wounded joints of the class now under consideration, are, with the addition of the injury to the bone, precisely similar to those already described under the head of simple wounds. In an advanced stage, the resemblance to the conditions produced by idiopathic disease is very striking. "In the dissection," says professor Thomson[1], "of many of the knee-joints after amputation, I found that the balls, in passing through the joints, had fractured the ends of the bones, and had occasioned, in the synovial membranes and cartilages, appearances very similar to those which occur in scrofulous affections of the joints. The cartilages were loosened in some instances from the bones, in others they were partially absorbed, and in the divisions of the cartilage produced by fracture, the edges were rounded off by absorption: the synovial membrane was much thickened in substance, and covered by soft, velvet-like, spongy granulations."

There are three methods of treatment which are applicable to wounds of joints complicated with injury to bone.

1. The case may be treated as a simple wound of a joint. This method is most applicable when the patient is young, when the joint is of comparatively small size, when the injury to the bone consists in a clean division, by a sharp instrument, or in a simple fracture, and when the soft parts are not extensively injured. In no case ought it to be adopted where the bone is so much injured as to forbid all hopes of its again forming part of an articular cavity, where surrounding soft parts are so contused as to render their sloughing away extensively, certain, where the previous health and habits of the patient have been bad, or where he cannot be placed under the circumstances of regimen and control favourable to a successful issue of the severe struggle that must ensue between nature and the disease. If, however, the patient be young, and of a sound, well-balanced constitution, if the circumstances be favourable, and the wound such as has been described, it is fair to try what can be done towards preserving the limb in all its integrity. The method of treatment pointed out as applicable to simple wounds of joints should be vigorously prosecuted; and the writings of Hey, Cooper, Larrey, and Guthrie furnish reasons sufficient for entertaining hopes of a favourable termination of such cases. Too great circumspection, however, cannot be shown in deciding on this course; for there is scarcely a

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[1] Hunter on the Blood, Inflammation, and Gunshot-wounds.

[2] Mémoires de Campagnes et Chirurgie Militaire, tom. iii.

[3] Cooper and Travers's Surgical Essays, part ii.

[1] Thomson's Report of Observations made in the British military hospitals in Belgium. Edinburgh, 1816.

more formidable train of symptoms than that presented in acute traumatic arthritis, and it too often happens when twenty or thirty hours have been suffered to pass away after the accident, without excision or amputation, that an opportunity has been lost which can never be restored. "Let us suppose," says Dupuytren[1], "one of the large articulations surrounded with muscles, tendons, and aponeurotic membranes filled with spicula, inflamed, suppurating, full of pus, and we shall have an idea of the gravity of the wound." It ought ever to be remembered, that life is the sacred deposit which is entrusted to our keeping, and that the churchyard often contains unanswerable arguments against the rules deduced from a few glittering cases.

2. The articulating extremities of the wounded joint may be excised, and the case treated subsequently as a compound fracture. Whatever may be thought of the excision of joints, idiopathically diseased, the general consent of surgeons has established the propriety of the measure when the lesion of the joint is traumatic; and the weight of testimony in its favour seems unanswerable. In 1814, Baron Percy informed Mr. Crampton, that by excising the articular extremities, he had repeatedly succeeded in saving limbs which otherwise must have been amputated[2]. In the campaign of Egypt, Larrey[3] ten times excised the head of the humerus, in cases in which he would otherwise have amputated at the shoulder-joint, and nearly all the patients recovered. In one remarkable case, he removed, with perfect success, the head of the humerus, the acromion process, the acromial extremity of the clavicle, the glenoid cavity, and part of the spine of the scapula. Sir Astley Cooper[4] records an immense number of cases of compound dislocation of the ankle-joint, in which the articulating extremity of the tibia was sawn off, and the results of the practice are contained in the following remarkable declaration:—"I have known no case of death when the extremities have been sawn off; although I shall have occasion to mention some in which the cases terminated fatally when this has not been done." The testimony of Hey, Taylor, Parke, Wachter, Balguer, and Guthrie, might be also quoted as to the efficacy of this measure. "As to the great articulations," says Dupuytren[5], "if the lesions are not extensive, and are confined to a single bone, we may substitute the resection of the injured bone for amputation."

The main advantage presented by excision is the preservation of the limb in a certain state of efficiency. The injured bone is removed, and a clean incised surface substituted for it; the cartilage, of which the ulceration can scarcely be prevented, is also removed, and much of the highly organized synovial membrane shares the same fate. The spasmodic contractions of the muscles, often productive of great mischief, and always of great distress, are prevented by the shortening of the limb which ensues, and the consequent relaxation of muscular fibre; no sharp osseous spicula are left to create and maintain irritation; adhesion between the sawn surface of one bone, and the cartilaginous surface of the other, is more readily affected; and the pabulum, so to speak, of high inflammatory action being removed, the constitutional suffering is greatly diminished. "The constitutional irritation," says Sir Astley Cooper[1], when speaking of excision in compound dislocation of the ankle-joint, "is very much lessened, both by the suppurative and ulcerative process being diminished, and the ease with which the parts are restored. In the cases which I have had an opportunity of seeing, there was not more irritative fever than in the mildest cases of compound fracture." After excision, ankylosis, sometimes osseous, but more commonly ligamentous, ensues. Larrey noticed, that when union took place by the first intention the bones became consolidated. Usually the bones are united to one another by ligamentous fibres of varying length and flexibility, but always admitting of a certain degree of motion, and the injured limb often acquires great strength and dexterity.

The circumstances under which excision is applicable remain to be stated. It may be practised immediately after the accident when the lesion is confined to the head of the bone. If the epiphysis be splintered, or a portion broken off, and the joint widely exposed, the most alarming result may be anticipated, if excision be not employed. If the body of the bone be much injured, and long fissures extend from the epiphysis downwards; or if the soft parts be so much lacerated and contused as to forbid the hope that the vitality of the limb can be preserved, excision will be contra-indicated. It may also be laid down as a general rule, that the excision of the joints of the lower extremities is unadvisable, while in the upper extremities its utility is very great. The causes of these differences are obvious. "Art may provide a clumsy substitute for the inferior extremities; but no ingenuity has hitherto succeeded in supplying the deficiency of that wondrous organ, the human hand. It is also evident from the purposes to which the inferior limbs are destined, that to be useful at all, each must possess a degree of strength corresponding to that of the opposite side. The two lower limbs constitute a single organ: they must unite to perform the functions for which they are designed; and one limb is of little use without the other, or a substitute of equivalent strength. The upper extremities, on the contrary, are two perfectly distinct and independent organs, capable of being combined to effect a given purpose, but equally capable of acting separately. Hence an inequality of length, power, and mobility in the upper extremities produces little inconvenience, compared with that arising from a similar state of things in the lower. The injured arm will be extensively useful as an assistant to the other, and will be adequate to the performance of many little offices; while the uninjured arm may be reserved for those occasions which require great strength and freedom of motion[1]." To this it may be added, that the large size of the articulations of the lower extremity renders the operation more dangerous, as a greater wound is inflicted. Where, however, the head of the femur is shattered by a ball, excision is unquestionably preferable, if other circumstances be favourable, to amputation at the hip-joint; and the success which has attended resection of the tibia, in injuries to the ankle-joint, furnishes ample warrant for applying the treatment to that articulation. There can be no doubt that in the upper extremity, excision is at least not more dangerous than amputations, and it ought therefore to be practised where any hope can be entertained of preserving the limb[2].

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[1] Leçons Orales de Clinique Chirurg. Paris, 1832, tom. ii.

[2] Dublin Hospital Reports, vol. iv.

[3] Mém. de Chirurg. Militaire, tom. iii.

[4] Sir A. Cooper on Dislocations and Fractures.

[5] Leçons Orales, tom. ii.

[1] Cooper and Travers's Surgical Essays, part ii.

3. The third measure which the surgeon may be called upon to adopt in treating wounds of joints complicated with injury to bone is amputation. Though always a painful resource, and never to be adopted until life and limb are laid in the balance against each other, it is often imperatively necessary. Attempts have been made to define accurately the cases in which amputation ought to be practised, but they have been signal failures, and such attempts will continue to be so until our knowledge of diathesis is much more extended. An injury the most severe and extensive will produce no alarming symptoms in one case, while in another the slightest and most trivial accident will rapidly develope fatal consequences. The constitution of the patient must therefore receive careful attention, not less than the character of the wound; and regard must also be given to the situation of the patient, as favourable or unfavourable to recovery. Modes of practice which would be wholly inadmissible in domestic surgery may often be expedient amid the hurry and confusion of a camp. When the constitution of the patient is bad, and his age advanced; when careful attention cannot be given to him, when he is placed in a crowded and unhealthy hospital, when the lesion is not confined to the articular apparatus, but extends into the body of the bone, when the soft parts are much lacerated or destroyed, when, to the injury of the joint, is added the rupture of a large blood-vessel, recourse must be had to amputation. When the knee-joint is extensively injured, there ought rarely to be any hesitation in amputating, since even if excision were performed, and the patient survived the long and tedious process by which the enormous wound must be healed, the superiority of the preserved limb to an artificial one would, in the majority of cases, be very questionable. In other joints, if excision furnish a reasonable hope, it ought to be practised, but when we dare not excise, we must amputate.

The only point remaining for consideration is the time at which amputation or excision, if deemed absolutely necessary, ought to be practised. Three stages have been described through which patients pass after wounds of joints attended with injury of bone. During the second of these, or the stage of acute inflammation, by the general consent of surgeons, amputation has been forbidden; but there has been a great question whether the operation be most advantageous in the first or third stage. English surgeons, with the exception of John Hunter, have long advocated the first stage, and the Continental surgeons of to-day are adopting the same opinion, though many of their predecessors opposed it, and the Academy of Surgery gave its sanction to the opposition. When the amputation is performed in the first stage, that is, within twenty or thirty hours after the accident, it is called immediate; when in the third stage, or after the lapse of several weeks, secondary. Among the advocates of secondary amputation, may be mentioned Faure, who gained the prize offered for the best essay on this subject by the Académie de Chirurgie, in 1756[1], John Hunter, whose experience, however, was not very extensive, and Lombard, professor of surgery in the Military Academy at Strasbourg. On the opposite side are found Wiseman, Le Dran, Boucher, Ranby, Larrey, Hennen, Copland Hutchinson, Guthrie, Dupuytren, and Velpeau. It is urged by the former party, that if the patient cannot withstand the inflammation developed by the wound, neither can he sustain the shock of amputation; that the amputation is a violence superadded to the injury, and therefore heightens the danger; that many of those amputations which are performed on the field of battle terminate fatally. Faure quotes ten cases which, after the battle of Fontenoy, were reserved for secondary amputations, and all of which were successful. To these arguments it may be replied, that by amputating immediately, the character of the wound is changed; that, instead of a ragged, lacerated wound, with sharp spicula of bone and an open cavity prone to active inflammation, we have a simple incised surface, smooth bone, and no danger of synovial inflammation; that if patients were reserved for secondary amputation, a large proportion would perish in the stage of active inflammation; that the fatality of amputations performed on the field of battle, even if admitted, may be readily accounted for by the extreme severity of many of the wounds, which renders the operation from the first all but hopeless, and by the want of proper attention subsequently. Dr White, a naval surgeon, who practised in 1703-4, upon the coast of Portugal, writes, "when amputations are requisite they succeed ten to one better where the operation is performed immediately after the misfortune, than four or five days after. This all our surgeons in the army very well know, as well as in the navy[1]." "The primary amputation," says Dupuytren[2], "will find the patient full of resignation, power, and courage: the secondary amputation will find him broken down, discouraged, exhausted, or armed with a resolution which will be fatal to him." But independently of all other reasoning, experience, our surest guide, is sufficient to decide the question. "During the peninsular war," says Guthrie[3], "the success of amputations performed on the field of battle became so notorious, even among the soldiery, that the anxiety expressed by them to have these operations performed with as little delay as possible was frequently prejudicial."

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[1] Blackburn on the Excision of Diseased Joints.—Guy's Hospital Reports, vol. i.

[2] For a fuller consideration of the value of excision, and for directions as to the treatment to be pursued after excision, the reader may consult the article RESECTION.

[1] Faure's memoir may be found in the Prix de l'Académie de Chirurgie, tom. iii. 12mo. Paris.

After the battle of Toulouse, forty-seven primary amputations were performed, of which thirty-eight were successful, and fifty-one secondary, of which only thirty proved fortunate. Of the primary amputations at the shoulder-joint performed after the battles of Vittoria, Pampeluna, and the Pyrenees, and the siege of St. Sebastian, the successful cases were as sixteen to one, while, out of nineteen secondary operations, performed in the general hospital, fifteen terminated in death.

Baron Percy, after the battle of Newborough, performed ninety-two primary amputations, of which eighty-six were unsuccessful[4]. Of sixty operated on immediately after the sea-fight of January 1, 1794, eight only died. After the battle of Aboukir, eleven soldiers were operated on immediately, all of whom recovered, and there were three consecutive amputations, all of which proved fatal. At the battle of Navarino, M. Del Seguore, surgeon to the Egyptian army, performed thirty-one immediate amputations, all of which were fortunate, and thirty-eight secondary, of which twenty-five were successful. After the three days of July, about a hundred amputations, primary and secondary, were practised, and the results were very decidedly in favour of the immediate performance of the operation[5].

These facts appear to be very decisive, and it will be readily admitted that, if any, the wounds of joints imperatively require immediate amputation, since the inflammation which follows them is much more formidable than that which follows the wound of any other part of a limb, and the hopes of restoration are much less. Mr. Guthrie very judiciously notices, that even in primary amputation, sufficient time ought to be given to allow of the recovery from the collapse which immediately succeeds the injury; and Roy, who was chief surgeon to the French army of the Rhine, in 1794, coincides in the opinion. Guthrie states, that he has seen more than one patient die upon the table when the operation succeeded the first shock, almost immediately. The best time for the operation is unquestionably that brief period which intervenes between the subsidence of the collapse, and the supervention of the first signs of inflammation. (For BIBLIOGRAPHY, vide the article ARTICULATIONS.)

(*John Blackburn.*)

ARTICULATIONS, ἄρθρον, Gr.; *articulus*, *arthrosis*, *junctura*, Lat.; *articulation*, Fr.; *Articulation*, or *Gelenk*, Ger.; *articolo*, Ital.

An articulation is the junction of two or more bones or parts performing the functions of bone. This is the only strict and logical definition which can be given of the term, unless we are to exclude from among articulations the varieties of synarthrosis called schindylesis and harmonia. In a more lax sense, the word may be understood to mean the junction of bones, or parts performing the functions of bones, by the intervention of a third structure or class of structures, so disposed as to admit of motion.

It would be remote from the object of the present article to enter into anatomical details, either general or descriptive[1], farther than is absolutely necessary to illustrate and defend the pathological views which will be advanced. The common anatomical division of articulations, which is grounded partly on form, partly on structure, and partly on mobility, may therefore be passed over in silence. For the purposes of the surgeon, a more convenient classification may be instituted on the basis of structure only. Viewed from this point, the articulations of the human frame will be found to resolve themselves into three classes. In the first class, of which the facial sutures furnish the chief example, surfaces of bone are simply adapted to each other, without the intervention or assistance of any other structure than the periosteal covering. In the second class, of which the type is found in the junctions of the vertebral bodies, the bones entering into the articulation are united through the medium of a third structure,—sometimes cartilaginous, as in the cranial sutures, but more commonly fibro-cartilaginous, as in the pelvic symphises,—which is interposed between them, and firmly united to the surface of each. Articulations of this class are in general strengthened by the addition of circumferential ligaments. In the third, or highest order, to which belong the joints of the extremities, the surfaces of the bones are covered with cartilage, and play upon one another; the connection is maintained by ligaments, disposed in various forms, and the motion is facilitated by the viscid secretion of a synovial membrane. Into several complex articulations of this class, there also enters fibro-cartilaginous tissue, sometimes disposed in the form of an intermediate layer between two surfaces of bone, but having no attachment to either, as in the inferior maxillary, sterno-clavicular and knee-joints,—at other times arranged around the margin of an articular cavity, forming what Meckel terms fibro-cartilages of circumference, as in the hip-joint.

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[1] White, De Rectâ Sanguinis Emissione. London, 1712.

[2] Leçons Orales, tom. ii.

[3] Guthrie on Gunshot Wounds.

[4] Velpeau, Médecine Opératoire.

[5] Op. Cit.

[1] Meckel's admirable treatise will furnish adequate information, both on general and special anatomy; or on the former subject, the reader may refer with great advantage to Dr. Todd's excellent article, "ARTICULATIONS," in the Cyclopædia of Anatomy and Physiology.

It is obvious that these different classes, ascending from the most simple form, in which a junction can be effected, to one very complex and intricate, will present striking differences in their proneness to morbid actions; and it will be found that this proneness is in close relation to the degree of complexity. In the simplest form of which bone is the only constituent, we meet with no articular disease, unless indeed we are to style as a disease their separation, which is described by Jourdain in the Dictionnaire des Sciences Médicales. The known diseases of the second class, though important and highly interesting, are comparatively few in number. The morbid states of the third class are very numerous, frequent in their occurrence, and often most disastrous in their consequences.

The lesions, of which joints are susceptible, arrange themselves naturally in two divisions, according as they arise from external or internal causes. The lesions belonging to the former of these divisions are three in number.

1. *Wounds.*—The wound of a joint consists essentially in an opening being made into the synovial capsule. This opening may be a simple penetration of the capsule by the point of a nail, or it may be the widest exposure of the articular cavity, attended with disruption of ligaments, and splintering of the head of a bone. In either case, the most energetic treatment is demanded on the part of the surgeon to prevent the fatal effects that frequently ensue.

2. *Sprains.*—A sprain consists in the violent distention or actual rupture of ligamentous fibres, without displacement of articular surfaces. It is the consequence of a strong effort to extend the motions of a joint beyond the limits which nature has assigned. It is not often produced by muscular action, or by force applied in a direction parallel to that of the ligamentous fibres. More commonly, it arises from the weight of the body being brought to bear on the ligaments obliquely. Hence it occurs most frequently in the ankle-joint, or in the wrist after a fall upon the hands. It has been customary to include, under the head of sprains, the morbid condition, termed diastasis, or relaxation of ligaments; but, as this condition arises from internal causes rather than from injury, it will be classed with more propriety among the idiopathic diseases of ligamentous tissue.

3. *Luxation.*—The application of force under certain circumstances may determine a change in the natural relations of the articular surfaces; either partial, as when the head of the humerus rests on the brim of the glenoid cavity,—or complete, as when the head of the femur is carried into the foramen ovale. This state of things occurs, most commonly, in joints of the third order, and, as a general rule, is found to be more or less frequent in them, according to the degree of mobility which they enjoy, the rationale of which is sufficiently obvious. When complete luxation is attended with laceration of the ligaments and synovial capsule, and with violent stretching or even rupture of the muscles inserted into the head of the luxated bone, when uncomplicated and recent, it is a lesion over which surgical skill has great control. Sometimes, however, it is complicated with a wound of the joint, in which case it is termed compound dislocation, and constitutes one of the most formidable accidents to which the human frame is liable. In articulations of the second order, luxation is not a very common occurrence, and is usually accompanied by fracture. Dislocations of the cervical vertebræ sometimes, however, occur without any such complication. Occasionally luxation is a consequence of disease in the articulation, but in this case the phenomena presented differ widely from those produced by external agency. The task of classifying the lesions of joints arising from external injury is not more easy than that of classifying their idiopathic diseases is difficult. Until of late years, no sound or correct basis of classification has been adopted. Symptoms were elevated into diseases, and diseases the most various were blended under one comprehensive title, until the whole subject became involved in inextricable confusion. The broad stream of light which morbid anatomy, aided by general anatomy, has thrown upon disease, has removed some of these evils, and every surgeon must feel gratification in paying a tribute of warm admiration to the merits of Sir Benjamin Brodie, by whose admirable researches the pathology of articulations may be said to have been created. Previously to the publication in the Medico-Chirurgical Transactions of the papers which formed the basis of Sir Benjamin's well-known and most valuable work on the diseases of joints, it was customary to rank all the serious maladies to which articulations are liable, under the convenient but unhappy term of white swelling. Thus Benjamin Bell treats of diseases of joints under the following heads:—1. Collections within the capsular ligaments. 2. Concretions and excrescences, within the capsular ligaments. 3. White swelling. Mr. S. Cooper makes a similar division, but adds a treatise

on arthritis. Boyer, the most minute and laborious of systematic writers, speaks only of foreign bodies, hydrops articuli, white or fungous swellings of joints, and ankylosis; and the classifications adopted by Delpech and other eminent surgeons are equally vague and indiscriminate. Even within the last few years, Mr. Liston, the author of a systematic work on surgery, has taught that it is a waste of time to attempt to distinguish between primary diseases of cartilage and of synovial membrane. "Such knowledge," he says, "is of no practical utility." That much yet remains to be done is indisputable, but we have the satisfaction of knowing that a great advance has been made, and of appreciating some of the deficiencies which still exist. I proceed to indicate the basis on which the division adopted in the present work will rest.

A correct and useful classification of the diseases to which any organ is liable, can be founded solely on a careful connection of the symptoms observed during life, and the order of their occurrence, with the appearances revealed to us by post-mortem examination. A perfect pathology would not only point out the structure in which disease had commenced, but would also determine the exact nature of the process which had been instituted. Hitherto pathologists have mainly directed their efforts towards the accomplishment of the former of these two objects, and rapid advances have been made in the localization of disease, while but little has been done in the way of investigating the various processes by which changes have been induced. There can be little doubt that under the broad term inflammation, which is applied indiscriminately to every organ, and almost to every abnormal state, we are including, not merely those modifications of morbid action which arise from structural peculiarity, but also various separate and distinct diseases. An illustration of these remarks may be found in the pathology of chest affections. The day has not long gone by, when the diseases of every structure connected with respiration were classed under the general head of inflammation of the lungs. We have now advanced, by the aid of a localizing pathology, to the recognition of pleuritic, pneumonic, and bronchitic inflammations. Other advances in the same direction may be made, by determining the exact tissue which becomes first affected in these several structures: but when this is done, there will still remain the questions, Is inflammation the sole disease? Is a pleuritis, which leaves behind it a clear serous fluid, or a muddy collection of pus, the same disease with a pleuritis which deposits a semi-solid, highly organizable lymph, rapidly becoming attached to the adjacent parts, and forming a fine web of cellular adhesions? Is a bronchitis, which is attended with the expectoration of a fibrinous tissue, taking the form of the bronchial ramifications, the same disease with a bronchitis which gives rise to purulent sputa scarcely distinguishable from pus? Is a pneumonia which leaves the lung thoroughly and permanently consolidated by a plastic lymph which becomes a part of the frame, in truth the same disease with a pneumonia which pours into the pulmonary tissue masses of a white, inorganizable product, rapidly softening down, and forming large purulent collections? These are questions to which subsequent researches may furnish more satisfactory answers than can now be given. It may be safely affirmed, that at present, with the slight and obvious exceptions of external injuries, and heterologue deposits, we know of few abnormal states which are not referred, directly or remotely, to inflammation. Even syphilis, gonorrhœa, and struma, are only specific inflammations. Attempts have indeed been made to introduce a process termed irritation, as something distinct from inflammation, but the medical world is so completely divided as to the meaning which is to be attached to the word, that for all practical purposes it is as yet unavailable.

There being therefore no satisfactory distinction between the processes by which morbid actions are carried on, the only sure basis which, in the present state of our knowledge, can be assumed in attempting to classify the diseases of articulations, is that furnished by the localizing pathology to which I have already alluded—the basis of tissue. Every living tissue is susceptible of morbid changes. Hence, in classifying the diseases of an organ, our first inquiry must be, into the tissues—whether common or peculiar—of which it is composed. I have already specified the tissues which enter into the composition of joints to be bone, fibro-cartilage, ligament, synovial membrane and cartilage, and I now proceed to point out the diseases of which each of these tissues is the primary seat, and to show how, in this manner, all the idiopathic diseases of articulations may be rationally comprehended.

1. *Bone.*—The portions of bone entering into the composition of a joint, consist of a mass of reticulated structure, endowed with a higher degree of organization than the shaft of the organ, and covered on the articular surface by a delicate layer of dense bone, to which the cartilage or fibro-cartilage is firmly attached. In this situation the bone is generally expanded, so as to form a protuberance, readily perceptible beneath the integuments; and the exposure to the influence of external causes which thence arises, combines with the high organization of the tissue to make disease a frequent occurrence. We find in it exemplifications of all the diseases to which bone is liable. Sometimes it becomes the subject of necrosis. This is not a very common occurrence, but I have seen a case in which a partial necrosis having taken place, one extremity of the dead bone protruded into the cavity of the articulation through an opening formed in the articular surface. More frequently it is the subject of inflammation, ending either in the formation of abscess within

the head of the bone, and indicated by a train of most alarming symptoms, to which Sir B. Brodie has called the attention of the profession, or assuming a chronic form, and slowly advancing to the state of confirmed caries. Beclard says that by this cause a separation of the shaft from the epiphyses is sometimes produced in young subjects, and the observations of Pott and Bromfield confirm the assertion. By far the most frequent disease, however, to which the articular extremities of bones are liable, is the inflammation and caries which depend upon scrofula, and which may not unreasonably be supposed to be connected with a deposit of tubercular matter in the cancelli of the bone. "Scrofulous diseases of joints," says Pott, "often commence in the very inmost recesses of the cellular texture of the heads of bones. In examining a joint in the early stage of this affection, we discover no trace of morbid change in the ligaments, cartilage, or synovial membrane, but on making a section of the bone it is found to present none of the cellular cavities proper to its normal state; and the striæ of bone which ought to be seen traversing its structure are indiscernible. An unbroken or granular surface is presented of a pale yellow colour, and the structure of the bone is softer than natural. At a more advanced period of the disease, this structure begins to soften down and ulcerate, the ligaments lose their connection with the bone, in consequence of the spread of the ulcerative process, the synovial membrane takes on a chronic inflammatory action, and the cartilage begins to be detached. At a still later period, abscesses form in and around the joint, which opens externally by long fistulous tracks; no trace remains of the ligamentous tissue; the synovial membrane has become so altered in character, that its peculiar features are no longer discernible; the greater portion of the cartilage is removed; the head of the bone is deeply excavated by ulceration, and so soft that it may be divided with a knife. The appearance of the remaining cartilage in this state of things is so peculiar, that it may almost be regarded as diagnostic of the disease. The removal of the cartilage commences on its attached surface, and it is not uncommon to see a flake of cartilage supported by its continuity with other portions of cartilage, over-hanging the diseased and excavated bone. On taking hold of a portion of this tissue it may be easily detached in flakes of considerable size from the bone beneath, which is dark, ulcerating, and denuded. In the cases of ordinary inflammation, such as are cited by Key, Mayo, and Gerdy, either granulations, by which the removal of the cartilage is supposed to be effected, are thrown out from the osseous surface, or the cellular membrane interposed between the cartilage and the bone, invisible in the healthy state, becomes highly developed and vascular; but in scrofulous caries the bone seems altogether incapable of this action, and presents, as already mentioned, a dark and denuded surface. A large proportion of the cases formerly termed white swelling, were undoubtedly of this class, as may be readily seen by referring to the excellent practical work of Crowther; and from the similarity of the attendant symptoms, it is not unfair to presume that the pathology of the morbus coxarius in young subjects is not widely different. Under the head, therefore, of articular osteitis, comprehending, in addition to the ordinary form of inflammation, that also which rapidly induces the death of the tissue and that peculiar lesion, which results from scrofula, we may legitimately include many of the diseases to which articulations are liable.

2. *Fibro-cartilage.*—This tissue established by Bichat, and termed by Beclard cartilaginiform ligament, is met with principally in joints of the second order, in which it forms the chief bond of union between the bones, though occasionally occurring as an accessory structure in joints of the third or more complex form. It is composed of fibrous and cartilaginous tissues, usually disposed with more or less regularity in alternating masses. Vessels have been traced into the substance of fibro-cartilage, but under ordinary circumstances they are not discernible; and the tissue, both in its physical properties, its low degree of organization, and its morbid appearances, presents a close resemblance to cartilage. Its diseases are very obscure, and much yet remains to be done towards elucidating them. When divided it re-unites, as is seen after the operation of symphysiotomy. Under certain circumstances we find it unusually developed, as when, for example, in consequence of subsided caries or disease in the intervertebral substance, a lateral curvature of the spine takes place. Bony ankylosis ensues on the compressed side, but on the opposite side the intervertebral substance becomes stretched and elongated. "The fibro-cartilages," says Velpeau[1], "may imbibe fluids, and we sometimes see them swollen so as to produce a considerable separation between the bones which they unite:" thus the symphysis pubis separates, to a small extent, at the time of delivery. Delpech[2] has noticed a sort of white swelling commencing in this tissue, and affirms that hydarthrosis may take place in the fibro-cartilaginous articulations. Ulceration is not a very uncommon occurrence in them. "In two instances," says Mr. Porter[3], "I have seen the intervertebral substance eroded at the anterior edge, the bodies of the adjacent vertebræ remaining unaltered in shape or consistence, and to every appearance in a perfectly healthy state." In the Museum of Guy's Hospital is a preparation in which the bodies of two vertebræ, entire in all their parts, and healthy, are completely separated from one another, by destruction of the inter-

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[1] Anatomie Chirurgicale.

[2] Précis Elémentaire, &c,

[3] Cyclopædia of Anatomy and Physiology, art. BONE.

vertebral substance. Sir Astley Cooper[1] believes psoas abscess to commence by disease between the spinal ligaments and intervertebral substance; with this opinion Mr. Key[2] coincides, believing that the fibro-cartilaginous tissue being little organised, and incapable of resisting the tendency to break down and ulcerate, is often the first structure attacked, while the bone, more vascular and highly organised, resists. A softened and apparently swollen state of this tissue is not unfrequently met with, and may be reasonably supposed to constitute the first stage of the ulcerative process. Fibro-cartilage shows a remarkable power of resisting the effects of pressure, and is sometimes found entire when the bodies of the vertebræ have been almost entirely removed by the pressure of an aneurismal sac. This is commonly attributed to the feebleness of organization, but may be also ascribed in a great measure to the remarkable elasticity with which this tissue is endowed. In fine, the fibro-cartilage has a strong tendency to ossification. Ankylosis of the bodies of the vertebræ is one of the most common of senile changes, and I have seen the cotyloid ligament of the acetabulum completely ossified, and forming a very distinct rim around the articulation.

3. *Ligament.*—Ligamentous tissue is met with in articulations in two forms: either as a broad layer of membrane enveloping the heads of the bones, and expanded on their surfaces, or in narrow funicular processes, stretching like cords between two points, and connected to bone only at the two extremities. It presents well-marked fibres, white, silvery, flexible, inelastic, and readily separable by macerations; no nerves, and but few vessels have been traced into its substance. It has no contractility, and in the healthy state, no sensibility. The important part which ligaments perform in articulations, and their liability to external injuries, furnish a presumption, that they contribute in no small measure to the diseases of these organs: but observations are as yet wanting to prove that they are the nidus of any serious articular disease. "I have never," says Sir B. Brodie[3], "met with a case where disease (independently of the effects of accident or of syphilis) was proved by dissection to have originated in the ligaments, and it may be safely asserted that this is a rare occurrence, and not what happens in the ordinary diseases to which joints are liable." Mr. S. Cooper[4] advanced many years ago, the opinion that white swellings generally commence in the ligaments, and within the last few years Mr. Key[5] has pointed out as a very common cause of disease in the hip-joint, ulceration of the ligamentum teres. In proof of this latter opinion, some striking cases are adduced, and those who are in the habit of examining diseased joints must have frequently observed this appearance. In fact, the frequency of its occurrence is sufficiently attested by the common spectacle of luxated femur following morbus coxarius. It will, however, be remembered, that when caries is proceeding, the ligaments rapidly lose their connexion with the carious surface. If, therefore, there be truth in the opinion already stated, that disease of the hip-joint, like disease of other articulations, frequently commences in caries of the articular extremities of bone, there will be some reason for believing that the destruction of the ligamentum teres arises from this source, and is a secondary not a primary lesion. It is, however, unquestionable, that ulceration of ligamentous tissue may take place, as the primary lesion. In the Museum of Guy's Hospital is a preparation in which the transverse ligament of the atlas has been ruptured in consequence of ulceration, and in which the ligament seems to be the only tissue affected. The early appearances of inflammation of ligaments have been very clearly described by Mr. Key. He states that the ligament becomes distended and feels pulpy; the fibres are found separated by a vascular structure which, on injection, has a villous appearance. This interstitial vascular mass is the reticular membrane that unites the ligamentous fibres. It becomes very vascular while the ligamentous fibres retain their natural glistening appearance, until at length they become softened and pulpy previously to undergoing absorption.

Although the ligaments are not as yet proved to originate any of the more serious diseases of joints, yet we seldom fail to find them implicated in the diseases which have commenced in other tissues. Intimately connected with both synovial membrane and bone, morbid changes are rapidly propagated to them from these tissues. In the advanced stage of ulceration of cartilage, or articular osteitis, the ligaments are frequently indiscernible in the mass of altered synovial membrane and cellular tissue, densely infiltrated with lymph which surrounds the joint. It is not improbable that they play an important part in producing the pain which attends diseased joints, as from their firm and unyielding character, they offer a great resistance to the distension occasioned by the accumulation of fluids within the cavity.

Among the few morbid changes of ligaments with which we are acquainted, the state termed diastasis, or relaxation, must not be forgotten. This is a condition gradually brought about by the long continued application of some elongating or distending force. Thus we see it frequently after the cure of hydrops articuli, or in the knees of children, who, from ill-health or other causes, not learning to walk, are carried on the arm of a nurse, with the legs hanging down unsupported, or in the shoulder-joints of persons whose arms are paralytic, and in whom the muscles, which form an important portion of the capsular ligament, losing their contractile power, suffer the weight of the arm to be borne by the ligament alone. An example of it may also be seen in the sinking of the arch of the foot described by Mr. Key in the third number of the Guy's Hospital Reports.

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[1] Sir A. Cooper's Surgical Lectures in the "Lancet."

[2] Med. Chir. Transactions, vol. xviii. p. 1.

[3] Brodie on the Diseases of Joints.

[4] Vide Mr. Cooper's Jacksonian Prize Essay.

[5] Med. Chir. Transactions, vol. xviii. p. 1.

4. *Synovial membrane.*—We here arrive at the only highly organized tissue which enters into the composition of joints. The articular synovial membranes are thin, soft, and translucent, well supplied with blood vessels, but not manifestly endowed with nerves, and secrete from their internal surface a viscid oily fluid, which serves to lubricate the motions of the hard structures. On the internal surface of many of the synovial capsules, chiefly at the margins of the cartilages, there are found plicæ, or reduplications of the membrane, analogous to the valvulæ conniventes of the intestines, and which contain within their folds, but external to the cavity of the joint, small pellets of fat, erroneously supposed by Havers and Portal to be glands secreting synovia.

The synovial membranes have been ranked, by Bichat and Beclard, among the serous, to which they present several analogies, but their peculiarities are sufficiently marked to constitute them a separate class. By the majority of anatomists, among whom may be mentioned W. Hunter, Sœmmering, Bichat, Meckel, and Beclard, they have been regarded as forming shut sacs, but this opinion has been impugned by Majendie, Gordon, Cruveilhier, Velpeau, and others, and as the question is one by the decision of which our pathological views must be considerably influenced, it will be necessary to enter into the discussion. It is affirmed by the authors last mentioned, that the synovial membrane is merely extended between the extremities of the bones, in the form of a capsular membrane, and does not extend over the surface of the cartilage. The arguments which they advance in support of this proposition are to the following effect:—1. Careful dissection does not separate from the surface of the cartilage any distinct membrane; or, if a membrane be raised it is only a thin lamina of cartilage, which is made to assume that form. 2. In inspecting diseased joints, where the free synovial membrane is densely injected, the cartilaginous surface retains its natural colour and healthy aspect, nor can delicate injections be made to pass over the surface of the cartilage. 3. If the joint of a living animal be freely exposed to the air, the cartilaginous surface becomes quite dry, while the synovial membrane extending between the bones is moistened by its natural secretion. 4. After disarticulations, when the cartilaginous surfaces remain exposed to view for many days, no morbid change developes itself, indicative of the presence of a synovial membrane, and the cartilage at length scales off in patches, or is lost amidst a crowd of granulations.

To these arguments it may be replied, that the synovial membrane covering cartilages is placed under circumstances widely different from those of a membrane expanded between the ends of bones. Exposed to constant pressure between two dense structures, it must necessarily have a most intimate union with the tissue over which it is spread, and the same cause must forbid the development in the normal state of vessels sufficiently large to convey red blood. We have an example of this adaptation of structures to meet particular circumstances in the change which the tunica conjunctiva assumes when it is expanded over the cornea. An analogous example is found in the arachnoid lining the dura mater, which from the comparative infrequency of its morbid changes, and the closeness of its union with the fibrous membrane to which it is superposed, has been affirmed by some not to exist: though the hæmorrhage which sometimes takes place between the two tissues as pointed out by Dr. Hodgkin[1], and many other evidences, are conclusive proofs to the contrary. It must be granted, therefore, that the synovial membrane, when reflected over cartilage, undergoes a great modification, but the following facts tend strongly to show that it still exists:—

1. By careful dissection, especially after continued maceration, a membrane can be distinctly raised from the surface of the cartilage, thin and transparent like a serous membrane, and continuous with the loose synovial membrane stretching between the bones. A more easy demonstration is effected by incising a layer of the cartilage, and then bending it back until the base by which it remains attached is broken: it will still hang pendulous to the surface of the joint, and if it be torn away cautiously, a piece of membrane, half an inch or an inch long, may be brought away with it. It cannot be supposed, that this membrane is a thin layer of cartilage, because cartilage being made up of perpendicular fibres attached to the bone, will not separate at right angles to its fibre or "across the grain," and also because the membrane thus demonstrated is so flexible that it may be rolled up, and again spread out, which would be impossible with a layer of cartilage however thin. "The existence of synovial membrane or cartilage," says Sir B. Brodie, "may be always demonstrated by a careful dissection."

"I am convinced by dissection," says Larrey[2], "that a very fine and delicate prolongaation of the internal fold of the synovial capsule covers the articular surface of the cartilage, to which this membranous pellicle is so intimately united that we can detach it only with the greatest difficulty and most delicate dissection. . . . . After having raised the pellicle, the cartilage, laid bare, offers rugosities."

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[1] Hodgkin's Lectures on the Morbid Anatomy of the Serous and Mucous Membranes, vol. i.

[2] Mémoires de Campagnes et Chirurgie Militaire, tom. ii. p. 425.

2. The bursæ mucosæ, which are structures in every way analogous to synovial membranes, the two being sometimes continuous and communicating with one another, as Meckel has pointed out, and the thecæ of the tendons, are indisputably shut sacs.

3. We occasionally see, in examining healthy joints, an extension of vessels from the free synovial membrane for a small distance over the surface of the cartilage. In examining the knee-joint of an adult fœtus injected with fine size, I could distinctly trace a number of injected vessels crossing over the surface of the cartilage nearly half way to the centre of the articulating surface of the femur. It is admitted by Cruveilhier and Velpeau that it is impossible to point out the line of demarcation between the synovial membrane and the uncovered cartilage, and this admission, combined with the presence of vessels, may go far to show that no such line of demarcation exists.

4. If we appeal to morbid appearances, the evidence is equally conclusive. In examining preparations of joints in which the cartilage is still entire, it is impossible not to be struck with the shreds of membrane which are seen hanging from the cartilaginous surface, sometimes light and flocculent, like floating villi, at other times broad and distinct. Whether these shreds are regarded as portions of synovial membrane, or as false membranes resulting from inflammation; they tend to prove the same point. Again, a cartilaginous surface may contract adhesions. Velpeau, without attempting to account for the phenomenon, affirms that after disarticulation, if union takes place by the first intention, the flaps adhere to the surface of the cartilage. In a case of osteo-sarcoma, affecting the lower portion of the femur, described by Sir B. Brodie, the femoral cartilage was found to be expanded over the tumour, and in several places to have contracted adhesions to the cartilage on the head of the tibia. In the Museum of Guy's Hospital there is a preparation in which the cartilage of the patella remains entire while a fine cellulo-membranous adhesion, nearly an inch in length, is seen stretching from it to the femur, of which the cartilage has been removed by ulceration. Other preparations show the same phenomenon, but from the ankylosis being closer, not with the same indisputable clearness. Mr. Mayo[1] notices a similar appearance in a knee-joint preserved in the King's College Museum.

Under acute inflammation, red vessels are occasionally developed on the surface of the cartilage, spreading from the circumference to the centre, exactly as the vessels of the conjunctiva covering the transparent cornea, become developed under similar circumstances. "In inflammation of these membranes," says Beclard[2], "their redness, which at length becomes perceptible, extends itself upon the circumference of the cartilage, gradually becoming less as we approach the centre of the membrane, identifying itself more and more with the cartilage; the centre itself in the end is penetrated by vessels, but the cartilage is coloured only on its surface, and preserves in its substance the white colour natural to it." I have never seen the redness extending quite to the centre, but I have seen it advancing towards that point. There is a preparation in the Guy's Museum which shows the synovial membrane of the semilunar cartilages, which does not naturally carry red blood densely injected, and in one of the cases detailed by Mr. Mayo[1], he states that the vessels of the synovial membrane, covering parts of the cartilage of the patella, the inner condyle and the semi-lunar cartilages, were filled with injection. A few similar facts will complete the argument. Hey, a most cautious observer, states[2], that in a case of compound dislocation of the ankle-joint, he distinctly saw granulations arising from the cartilaginous surface of the astragalus. In three out of eight cases of the pulpy degeneration of synovial membrane described by Sir B. Brodie[3], the alteration had extended more or less completely over the cartilaginous surfaces, the cartilage beneath remaining entire. Cruveilhier[4] himself, states that he has seen fungous granulations arising from a cartilaginous surface, and candidly admits his inability to account for the phenomenon consistently with his own hypothesis. Mr. Mayo cites a case similar to that detailed by Cruveilhier. Lastly, we find that cartilage becomes yellow in icterus, and that, in those cases of gout in which the urate of soda is copiously deposited in the interior of a joint, the deposit takes place not merely on the free synovial membrane, but also on that covering the cartilage.

I have entered at length into the discussion of this question, not only because it is in itself of great importance, but also as it is intimately connected with some other disputed points presently to be brought under notice. The facts and arguments seem pretty conclusive, and I proceed to point out that the synovial membrane is more prone to disease than any other articular tissue. It is susceptible of inflammation in all its forms. Cases have already been quoted in which ankylosis had taken place between the cartilaginous surfaces, and in which, consequently, there had been adhesive inflammation. In the first case cited, and in Sir B. Brodie's work, there was found a thin flake of coagulated lymph about the size of a half crown-piece effused from the inner surface of the synovial membrane; and the author states that he has seen several cases in which there was every reason to believe that inflammation had produced adhesions more or less extensive of the reflected folds of the membrane to each other, and has occasionally observed such partial adhesions as may be supposed to have arisen from inflammation at some former period. This phenomenon, however, is not of very common occurrence. More frequently we meet with an inflammation attended with copious secretion of altered synovia. This may assume the most mild form, revealing itself only by swelling, a feeling of fluctuation when the joint is pressed upon, and a very slight degree of weakness and uneasiness in the limb. This state constitutes what is commonly termed hydrops articuli. By the surgeons of the last age it was classed as a distinct disease, but no good reason can be assigned for excluding it from among the forms of synovitis. In a more decided state of inflammation, the swelling of the joint is less notable, but the pain is greater though still not severe, and unless checked, the disease slowly, but certainly, proceeds to attack every other tissue in the joint, and produces the most complete and remediless disorganization. Between this chronic form and the most acute, the inflammation may assume various shades of severity, which have been most clearly and graphically sketched by Mr. Key, in the Med.-Chir. Transactions. The various forms blend into each other so imperceptibly, and one may so rapidly pass into the other, (the most chronic into the most acute, or *vice versâ*,) that it is impossible to draw any clear lines of distinction between them. In the most acute form, the disease may entirely and permanently cease after the lapse of a short time, as we occasionally see in traumatic synovitis occurring in a healthy subject; or it may subside into a chronic action, continuing for months or years, always liable to become again acute, and to involve the surrounding structures; or it may take on a suppurative form, producing speedy ulceration of the membrane, and placing the patient's life and limb in imminent peril.

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[1] Med.-Chir. Transactions, vol. xix.

[2] Anatomie Générale.

[1] Med.-Chir. Transactions, vol. xix.

[2] Practical Observations, &c.

[3] Brodie on the Diseases of Joints.

[4] Archives Générales de Médecine, 1824.

Sir Benjamin Brodie has described as something distinct from inflammatory action, and corresponding to the heterologue deposits, such as cancer and tubercle, a pulpy degeneration of the synovial membrane. The symptoms which usher in, and accompany this disease, and the course which it pursues, bear a close resemblance to chronic synovitis. I have in one instance seen appearances precisely similar to those described by Sir Benjamin. The synovial membrane passing from bone to bone, and forming the mucous ligaments, was thickened to about the third of an inch, firm and elastic, of a light yellow colour, chequered by white striæ. In this case, the history and symptoms appeared to indicate that the disease had commenced in the bone, and this was confirmed in a great measure by the state of the bones and cartilage discovered on examining the limb after amputation. Until some further light is thrown upon the subject, it may be allowable to include the disease among the forms of synovitis. The synovial membrane may, however, be the seat of very distinct heterologue formations, as will be seen by a reference to the article "Diseases of Synovial Membrane."

Along with the diseases of the synovial membrane itself, it will be most in accordance with the practice of modern pathologists to mark the diseases incident to the sub-synovial cellular tissue. This tissue, of which the existence between the cartilage and its lining membrane is only inferred from analogy, is very fully developed around the other portions of the synovial capsule. It shares in the inflammation of the membrane to which it is attached, and, becoming infiltrated with lymph, tends materially to produce the thickened state of the synovial membrane commonly observed in diseased joints. The most interesting light, however, in which it can be regarded, is as the nidus in which are developed the loose cartilages of joints which have so long engaged the attention of pathologists. The union of many observations has now furnished a tolerably clear account of the origin of these bodies. They are rarely, if ever, purely cartilaginous, but are composed of a mass of bone covered with a layer of cartilage. They seem to originate in some comparatively slight and local inflammation of the sub-synovial cellular tissue. In all the cases related by Hey, their formation had been preceded by a sprain or contusion of the joint in which they occurred, and some other observers have noticed the same antecedence. M. Velpeau supposes[1] that this accident had determined a slight extravasation of blood in the cellular tissue, and that this extravasated blood becomes organized; but facts are yet wanting to show the possibility of such a process, and it is more in accordance with known pathological phenomena to suppose that an effusion of plastic lymph takes place, which becomes penetrated by the vessels of the surrounding parts. Remaining in this situation, they gradually assume the osteo-cartilaginous character. Analogies to this transformation may be found in the cartilaginous patches frequently met with on the surface of the liver and spleen, in the large osseous masses which form behind the pleura after an old pleuritis, and in the plates of cartilage which are observed at times on the attached surface of the arachnoid. The cartilaginous incrustation which covers them furnishes an example of the very curious and interesting law pointed out by Dr. Hodgkin[2], that the character of a new product is influenced by the character of surrounding parts. They have been found by many observers in this situation lying beneath the synovial membrane. Protruding this membrane before them like a hernial sac, they impinge upon the articular cavity, at first attached by a broad base, which gradually becomes narrower, until it is reduced to a slender peduncle, after which the connexion is speedily broken and the body becomes loose in the joint. This process has been traced through all its stages. Sir B. Brodie has seen them covered by the synovial membrane. Begin[1] states that he has met with them sometimes lying beneath the capsule, and scarcely projecting into the joint, at other times hanging by a long and slender peduncle. In the Museum at Guy's Hospital, is a preparation which shows four of these bodies in the elbow; two appear to have been lying loose, but the other two are attached to the synovial membrane by slender filaments. In Cruveilhier's ninth *Livraison*, a very beautiful plate is given in which these bodies are figured in the knee-joint. Two small ones are lying beneath the synovial membrane without producing much protrusion; a third is more prominent, and pushes forwards the membrane distinctly; while a fourth, just ready to be detached, is hanging into the cavity by a long and delicate pedicle. The subject of loose cartilages may, therefore, in consistence with the guidance of a sound pathology, be considered along with the diseases of synovial membrane.

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[1] Anatomie Chirurgicale.

[2] Lectures on the Morbid Anatomy of the Mucous and Serous Membranes, vol. i. London, 1836.

From the synovial membrane, I proceed to the only tissue which yet remains to be considered.

5. *Cartilage.*—Articular cartilage presents itself in two forms, either synarthrodial, such as is met with between the sutures of the cranium, or diarthrodial, as it occurs in the more complex articulations. In this latter form, it is found to be a dense, very elastic substance, intimately connected by one surface to the head of the bone, and on the other lined by a synovial membrane. After long maceration, it is found to consist of straight and parallel fibres, arising, says Dr. Hunter[2], from the bone like the pile of velvet. Its organization is probably inferior to that of any other tissue. Nerves have not been traced into its structure, nor in the healthy state red vessels. "The cartilages," says Meckel[3], "do not receive vessels which convey red blood, although in cutting them we frequently perceive distinct vessels in their substance." From some observations recorded by two careful anatomists, W. and T. Arnold, in the Physiological Journal of Tiedemann and Treviranus, it appears that in the fœtus of the fourth, fifth, and seventh months, the articular and permanent cartilages consist of numerous granules. The temporary cartilages exhibit the same structure, but in particular points are more closely approximated. These points are more distinct as ossification advances. In adults, they state that cartilage appears to be a white mass composed of granules irregularly heaped together. These masses contain interspaces which are for the most part four, five, or sexangular, but irregular, and sometimes more of a rounded, oval, or other form.

I have been more particular than I should otherwise have been in describing the general anatomy of cartilage, because Messrs. Velpeau and Cruveilhier, the one the most learned surgeon, the other the most eminent pathologist in France[1], have adopted the opinion that the articular cartilage is a mere epidermic crust, endowed with no organic life, and hence insusceptible of disease.

These novel opinions are supported by some plausible arguments, and as the influence which they are calculated to exert on our pathological views is of great consequence, it will be necessary to enter into an examination of them. The doctrine was first, I believe, propounded by Cruveilhier, in a paper read before the Philomathic Society, in the latter part of the year 1823, and published in the Archives Générales for February, 1824. The arguments which he adduces are to the following effect:—

1. Lay bare an articulation: treat the cartilage violently by pulling, pinching, cutting, or tearing it; and it will evince no signs of inflammation, nor will there be the smallest pain produced.

2. If the spongy extremity of a bone be perforated by a piercing instrument, or a heated iron, and the cartilage bruised or simply touched, without the application of any force to destroy its texture, still the result is the same; nothing ensues but elimination or absorption.

3. Where necrosis takes place, though frequently a very thin lamina of living bone separates the dead bone from the cartilage, the cartilage remains sound.

4. Cartilages laid bare in disarticulations, either fall off or do not become attached to the soft parts.

5. Cartilage, when broken or divided in its continuity, does not offer any token of reparative effort.

6. In reading the accounts of the dissections of diseased joints, we generally find the striking clearness and healthy appearance of the cartilage contrasted with the extent of the surrounding lesions.

7. In ankylosis, the cartilage is invariably removed.

These arguments are in the main repeated by M. Velpeau, in his Anatomie Chirurgicale. The cartilage, he says, being only an incrustation without organic web, cellular tissue, vessels, nerves, or marrow, the whole thickness of the cartilage enjoys no sensibility. Hence, it cannot be the primitive seat of any malady. It never inflames nor suppurates. The cellular patches which we sometimes observe over the whole surface of the cartilage are foreign to it. They spring from the osseous substance. Sometimes they are shown at once upon the cartilaginous patches which they have raised; at other times, they cross over from the circumference to the centre, but the cartilage always disappears before them without ever contributing to produce them. After disarticulations, the cartilages will remain in contact, with dressings, for many days without undergoing any morbid change. They fall off by patches, or disappear in the midst of vascular layers of membrane, but never show any trace of synovial membrane, softening, vascularity, thickening, or any other morbid lesion: a true epidermis of the bones, they retain merely the characters of a protecting crust, entirely inorganic, and susceptible only of physical and chemical lesions. No ankylosis can take place until the cartilage is removed.

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[1] Dictionnaire de Médecine et Chirurgie Pratique, Art. Corps Etrangers.

[2] Hunter on the Structure and Diseases of Articular Cartilage. Phil. Trans. vol. xlii.

[3] Meckel's General and Descriptive Anatomy.

[1] The views of these gentlemen may be found in the Archives Générales de Médecine, vol. iv. 1824. Dictionnaire de Médecine et Chirurgie Pratique, art. Articulations. Anatomie Chirurgicale, par Velpeau.

Of the facts and arguments here adduced, some are most undoubtedly mistakes; while others, though true in themselves, are explicable on another principle than the absence of vitality. To the former class belongs the assertion made by Cruveilhier, and repeated by Velpeau, that ankylosis can never take place until the cartilages are removed. In a former part of this article, I have cited examples in which distinct bands of adhesion, constituting soft anchylosis, are attached to the cartilaginous surface, and I have also cited the concurrent testimony of Brodie and Mayo to the same purport. The proposition laid down by Cruveilhier, that after disarticulation the flap does not adhere to the cartilaginous surface, is refuted by Velpeau himself, who even chides Beclard for asserting the contrary. The affirmation of Velpeau, that the cartilages never swell, soften, or exhibit any morbid lesion, is equally incorrect, as I shall presently show; and not less fallacious is the assertion of Cruveilhier, that when a solution of continuity takes place, the cartilages show no trace of reparative action. On the contrary, if a divided cartilage, whether articular or sterno-costal, be examined some time after the division has been made, a tissue, not indeed cartilaginous, but more allied to ligament, will be found uniting the incised surfaces and closely adherent to each. To the remaining arguments adduced, which are drawn entirely from the persistent character of cartilage and the slowness with which it takes on any morbid action, it may be replied that this tissue is unquestionably of low organization, and presents few changes, but that if one single example of morbid change can be satisfactorily established, the whole argument on their part falls to the ground.

It is true that cartilage may be lacerated and bruised without the production of any of the ordinary signs of inflammation, heat, redness, pain, and swelling; but the ligaments and fibro-cartilages, both of which are confessedly endowed with vitality, may be treated in the same way, and the former will at the time evince no sensibility, while the latter will not present any traces of inflammation more distinct than those evinced by cartilage.

The following considerations may also be urged as directly contravening the views of Messrs. Velpeau and Cruveilhier.

1. It is difficult to conceive how the cartilage, if merely inorganized matter, can keep pace with, and undergo, changes corresponding to the gradual development of the animal. Adapted in infancy to the small size of the articular surfaces, it augments in bulk and expansion as life advances. Though exposed to constant pressure and a degree of friction which no inorganic substance with which we are acquainted could endure without sensible diminution, it maintains its form and volume uninjured. As life advances, it undergoes changes corresponding to those observed in other tissues. In the fœtus soft, muciform, and transparent; in the infant still transparent, soft, and but slightly elastic; in more mature years assuming the dense, hard, and elastic character by which it is commonly known; it becomes in old age, yellow, more dry and opake, less flexible, less elastic, loaded with a greater portion of earthy matter, and sometimes in the end completely ossified. Surely these circumstances tend to show that a process of nutrition is constantly going on,—obscure, indeed, to our perceptions, but which we ought not to deny simply because we cannot comprehend.

2. From this point of view let us turn to consider the evidence deducible from tissues identical with, or closely analogous to, articular cartilage. Beclard and the majority of anatomists assert that in the fœtus the articular is distinctly separate from the temporary cartilage, but an actual examination of fœtal limbs will show that his observation is by no means universally correct. In the full-grown fœtus, except where the process of ossification is very far advanced, I, and others with me, have several times failed in discovering any actual line of demarcation, and even when ossification is advancing, the temporary cartilage interposed between the vessels and around the osseous spots, has precisely the diaphanous gelatinous appearance which is seen at the extremity of the bone. The minute observations of the Arnolds, already quoted, tend to the same conclusion. If, therefore, the tissues be so clearly correspondent, is it not reasonable to infer when the one is manifestly endowed with life, that the other possesses the same attributes? Again, the cartilages of the ribs, and the thyroid and cricoid cartilages, which so closely resemble articular cartilage in physical properties and intimate structures, betray evident tokens of vitality. They are invested by a distinct membrane; after division they reunite, and as life advances, they are frequently the seat of accidental ossifications. At the period of puberty, the thyroid cartilage undergoes a manifest and extraordinary change, which argues a great activity of nutrition, and every surgeon has seen ulceration of this structure, following

syphilis treated by mercury. Here, therefore, the argument from analogy has great cogency, and the morbid changes which the fibro-cartilages undergo furnish additional evidence of the same character.

3. The conclusions deducible from morbid anatomy are still more striking and decisive. It is true that the effects of diseased action are not displayed in articular cartilage in the same way as in most other parts, but it must be remembered that the phenomena of ulceration vary with the varying tissues in which they are manifested. Whatever view we may adopt of the ulcerative process, the fact will remain the same, that this action goes on in cartilage. Very frequently, on opening a joint, we find the cartilage removed at some points, and the bone exposed; around the margins of this denudation the cartilage is seen to be distinctly softened, a little swollen, and bevelling down upon the bone; while in other parts the same process has produced slight pits and fossæ on the surface, not yet extending to the osseous structure. I have several times distinctly and carefully noticed this appearance, which is inexplicable on any other supposition than that the process commences in the cartilage itself, and its occurrence has been confirmed by the testimony of other observers, among whom I may cite Brodie, Hey, Mayo, and Wickham. In other cases, as Beclard and many others testify, we find the cartilage not having as yet undergone any actual destruction, but softened or even pulpy, and hanging in villous fibres, or fringed brush-like projections into the cavity of the joint.

In the Dictionnaire de Médecine et Chirurgie Pratique, Cruveilhier himself describes this state of things, and candidly avows his inability to account for it, unless by a process instituted within the substance of the cartilage itself. Another statement made by Cruveilhier, in his ninth *Livraison*, to the effect that after gout he has found the urate of soda deposited not merely on the free surface, but in the very substance of articular cartilage, is equally irreconcileable with the opinion that this tissue enjoys no organic life. In the Museum of Guy's Hospital there is an interesting preparation of the hip-joint, in which ulceration is seen to be proceeding at the edges of the femoral cartilage, and in the neighbourhood of the ligamentum teres. At a little distance from this ulceration are seen two or three much raised button-like projections, not having the fibrous brush-like appearance already described, but of uniform surface, and closely resembling the protrusion which takes place of the semifluid centre of the intervertebral substance, when the bodies of two vertebræ are separated. Around these projections the cartilage is entire. I am at a loss to account for this appearance, and have never seen anything precisely similar; but the conclusion to be drawn from it, that the tissue in which it occurs must be organized, is undeniable. In fine, it may be added, that Brodie and Mayo concur in asserting that in cases where ulceration of cartilages has been consequent to articular osteitis they have repeatedly seen red vessels passing into the substance of the cartilage.

From this mingled series of analogies and facts may be deduced the conclusion that the articular cartilage is a living tissue, susceptible of morbid action, and amenable to the same great laws of life which preside over every other portion of the frame. There yet remains to be noticed a doctrine connected with the ulceration of cartilage, similar in some points to that advanced by Cruveilhier and Velpeau, as it is founded on the confessedly low organization of this structure, but incomparably better supported by facts and arguments. I allude to the ingenious and original views propounded by Mr. Key in a paper on the Ulcerative Process in Joints, published some years ago, in the Med.-Chir. Trans., and subsequently supported by further observations transmitted to the public through the same medium. Very erroneous views have been entertained with respect to these opinions, and I shall seek to state them as concisely and clearly as possible. Mr. Key admits that primary ulceration of the cartilage may, and does, occur, but contends that the removal of cartilage, which takes place consecutively, to synovitis, or osteitis, is not an ulcerative act commencing in the cartilage, but a process of absorption set up by the surrounding previously affected tissues, for the removal of a body obstructive to the process of ankylosis by which a disorganized joint is repaired.

To show that such a process may be carried on by the vessels of one tissue upon another, Mr. Key cites the case of a necrotic bone in which the portions of sequestra corresponding to the cloacæ in the new shell are found smooth and entire, while those completely surrounded by the regenerated bone are worm-eaten, in consequence of absorption instituted by the villous fringes prolonged from the interior of the living case. The other arguments urged by Mr. Key are principally as follows:—cartilage is of such low organization, that absorption can scarcely be supposed to take place within its structure. After synovitis, and where ulceration of cartilage has occurred, this process is generally found to have commenced at the margins of the cartilage, and vascular prolongations from the synovial membrane are found loosely attached to the ulcerating spots. A similar state of things is observed in those cases where grooves are formed along the cartilaginous surface. To these grooves a highly-injected and newly-developed false membrane accurately applies. Where ulceration follows osteitis, the cartilage is first removed on its attached surface; and where this process of removal is going on, a vascular membrane is found to have shot up from the surface of the bone.

I am ready to confess that the preparations adduced by Mr. Key in support of these views are very striking, and that the principle of absorption, by the vessels of another tissue, would solve some difficulties in the pathology of cartilage ; but there is reason for believing that greater difficulties would follow its adoption. In the first place, as to the example of a necrotic bone, it must be remembered, that facts are still wanting to prove the possibility of the absorption of a foreign solid body, such as a dead bone, by living vessels. Bullets and shot remain for years imbedded in the body without undergoing any perceptible change ; and dead bones have been inserted into the medullary canal of living bones, have remained there for years, and on examination have been found entire. Indeed, it occasionally happens, that the whole of the dead shaft of a bone, whether opposed to cloacæ or not, preserves its smoothness ; and the more common occurrence of an irregular surface, smooth at one place and worm-eaten at another, may be accounted for by the fact which has been clearly established by Weidmann in his erudite and masterly Treatise on Necrosis, that often the centre of the shaft does not perish, but the bone dies irregularly. If, however, it were admitted, that this process of absorption does take place in necrosis, the argument, though rendered more probable, would still be inconclusive, inasmuch as there is a want of analogy between dead bone and living cartilages. The difficulty would still remain, that we know of no instance in which the vessels of one tissue, or of a newly developed membrane, are employed to effect the destruction of another tissue. And the argument may be pushed still further. It has been already established, that the cartilage is invested by a synovial membrane. In those cases in which the absorption is said to commence on the free surface, as in synovitis, the vessels which carry on the process must make their first ravages on the membrane. If, therefore, the opinion combated be adopted, we shall have here the anomalous spectacle of a suicidal membrane prolonging its vessels, or throwing out a new membrane to effect its own annihilation ; like the fabled scorpion, girt with fire, that turns its venom inwards, and perishes self-destroyed.

The argument drawn from the common commencement of ulceration at the margin of the cartilage, will apply equally to another view of the process by which this is effected. If, as there are many reasons for believing, the destruction of the cartilage commences by an inflammation propagated to it, from the inflamed synovial membrane, in obedience to the law of morbid action which so frequently connects pleuritis with pneumonia, and which reveals to the practised surgeon the state of a hernial sac by the state of its investments, then it is easy to perceive why that portion of the cartilage which is in closest proximity to the inflamed membrane should first be affected. In a similar way the vascular prolongations which are found in the interior of a joint may be shown to be simply the ordinary results of inflammation, and not necessarily endowed with powers unknown in any other organ. These vascular fringes are of two sorts—sometimes abnormal developments of the synovial tissue, at other times actual productions of a new membrane. In the first case, the folds or reduplications which, as was observed in the brief sketch of the anatomy of synovial membranes, are frequently seen in the interior of a joint, and most commonly at the margin of the cartilage, become, under inflammation, excessively tumid and injected, and overlap the cartilage, exactly as in pannus or pterygium, the conjunctiva becomes enormously developed, in consequence of inflammation. In the second case, where a new membrane is thrown out, we have a state precisely similar to that which is every day seen in the serous membranes, when coagulable lymph is effused, and being permeated by the vessels of the neighbouring parts, acquires organization. It may be farther observed, that ulceration of cartilage follows synovitis in joints which, from their form and construction, seem scarcely capable of admitting the prolongation of vascular fringes between the articular surfaces ; as, for example, the wrist and tarsal joints. In fine, since in the intervertebral substance, which is scarcely, if at all, superior in vitality to articular cartilage, ulceration may go on, though no synovial membrane is involved ; and, since it is admitted, that ulceration of cartilage may occur as a primary affection, does it not seem fair to conclude, that the removal of this tissue, when occurring as the secondary effect of adjacent lesion, is self-effected, and does not require the intervention of a process different from any which is known to occur in other positions of the frame ?

If the opinions now advocated be correct, the account which may be given of the diseases incident to articular cartilage is brief. There seems to be no intermediate stage between inflammation and ulceration, unless we are to regard as such the slightly swollen and softened state in which cartilage is sometimes found around an ulcerating spot. To avoid the necessity of a needless periphrasis, the term chondritis will be employed to designate this morbid condition. The tissue may be either primarily or secondarily affected. When primarily affected, the ulcerating process sometimes goes on for a long period without involving any other structure, but more commonly the surrounding parts speedily participate in the lesion, synovitis makes its appearance, the bone becomes inflamed, and at length the malady terminates, either in the establishment of ankylosis, or in the entire disintegration of the organ, demanding amputation or excision. When secondarily affected, the cartilage takes on a diseased action in consequence of the spread of inflammation from the seat of the primary lesion to the contiguous parts. If that primary lesion has been in the synovial membrane, the cartilage will ulcerate on its free surface, first becoming gradually thinner, till the bone is denuded ; if in the bone, the reverse will happen, and a highly characteristic appearance will be presented on opening the joint.

Cruveilhier has described, as the only disease of which cartilage is susceptible, a rubbing or wearing away, in consequence of long-continued friction. It is evident that he is describing a process in which a certain change takes place in the cartilage analogous to ossification, and producing a remarkable eburnated or porcelain appearance of the head of the bone. This is rarely observed to happen, except as an accompaniment of rheumatism, and it will fall to be considered under the head of Eburnation.

Under these heads, then, it appears that all the idiopathic diseases of articulations may be included consistently with the dictates of a sound pathology. But our view would be incomplete, were we to exclude two very curious and interesting processes which may not inappropriately be styled the efforts of nature to remedy the effects of disease—ankylosis and pseudarthrosis.

Ankylosis consists in the union of articular surfaces so as to limit or prevent motion. It may be osseous, as we frequently see in the vertebral column of persons advanced in life, or ligamentous, of which, examples are met with in old diseased joints. The former is called true, the latter, false ankylosis. The former is very common in articulations of the first and second order, which, indeed, are susceptible of no other species; the latter is more frequent in the third or most complex class of joints. A sort of pseudo-ankylosis is often met with, resulting from the rigidity of the parts surrounding a joint, or from the loss of the due balance of muscular action. The former is exemplified in the contractions which follow disease of cellular membrane around a joint, as described by Mr. Wickham, and in the contraction of the finger dependent on an abnormal state of the palmar fascia: the latter is exemplified by the rigidity of the phalangeal articulations in old cases of paralysis from lead.

Pseudarthrosis, or the formation of a false joint, is an extremely interesting phenomenon, and assumes several different aspects. It takes place in enlargement of the heads of the bones, in old ununited fractures, in unreduced dislocations, and after excision of the articulating extremities. Occasionally there seems to be an actual epigenesis, or creation of new tissues, and the new joint is endowed with an articular cavity, cartilage, ligament, and synovial membrane, of which examples, both in man and the lower tribes, have been recorded by Sir Astley Cooper, Mr. Key, Chaussier, Koëler, Wachter, and others. More commonly the joint consists simply in the connexion of two bones by a ligamentous structure, more or less flexible, but always admitting of a certain extent of motion. This is almost invariably the condition of the false joints formed after excision, or in old ununited fractures.

I have now explained and defended the classification of the diseases of joints which will be adopted in the Cyclopædia of Surgery. That it is open to some objections I am very sensible, but I know of no other arrangement which would be equally consistent with the actual state of our pathological knowledge. To resume, the present article may be considered as the prolegomena to the whole subject, and the different abnormal conditions of articulations will be considered under the following heads:—

1. Lesions resulting from external injury.
    - Wound.
    - Sprain.
    - Luxation.
2. Idiopathic diseases.
    - Articular osteitis.
    - Diseases of fibro-cartilage.
    - Diseases of articular ligaments.
    - Diseases of synovial membrane.
    - Synovitis—acute and chronic.
    - Chondritis, or ulceration of cartilage.
3. Processes the result of disease, but not in themselves morbid.
    - Ankylosis.
    - Pseudarthrosis.

The reader will find these subjects taken up in their alphabetical order in other portions of the Cyclopædia.

Bibliography.—All the systematic works on surgery may be consulted, and there are few medical journals or surgical miscellanies which do not contain articles on the diseases of joints. The following books and papers well deserve consultation:—Cyclopædia of Anatomy and Physiology, art. Articulations. *Brodie*, Pathological Observations on Diseases of Joints. *Boyer*, Sur les Maladies des Os. *Crowther*, On White Swelling. *Cruveilhier*, Sur les Cartilages Diarthrodiaux. Arch. Gén. de Médecine. Feb. 1824. *B. Cooper's* Surgical Essays. *Curtmann*, Morborum Articulationis ac Symphyseos brevis Ætiologia ac Diagnosis. Giessæ, 1797. *Champigny*, Dissertation sur les Corps Etrangers qui se forment dans les Articulations. Paris, 1803. *Doernér*, De Gravioribus quibusdam Cartilaginum Mutationibus. Tubingen, 1798. *Enckelmann*, De Fungis Artic. Argentor. 1749. *Ford*, On Diseases of the Hip-joint. *Hunter*, On the Structure and Diseases of Articular Cartilage. Phil. Trans. vol. xlii. *Herdman*, On White Swelling and Inflammation. *Heyligers*, Dissertatio Physiol. Anat. de Fabricâ Articul. 1803. *Haase*, De Fabricâ Cartilag. Lips. 1767. *Howship*, On the Formation of New Joints, Medico-Chirurgical Transactions, vol. viii. *Isenflamm*, Dissertatio de Ginglymo, Erlangen, 1785. *Key*, On Ulceration of Joints, in Medico-Chirurg. Trans. vol. xvi and xix. *Kreisig*, De Fungo Articular. Viterb. 1799. *Mayo*, On Ulceration of Cartilage in Medico-Chirurg. Trans. vol. xvii. and xix. *Moffait*, Sur les Phlegmasies des Membranes sereuses des Articulations. Paris, 1810. *Pirondi*, De la Tumeur blanche des Genoux. Paris, 1836. *Russell*, On Morbid Affections of the Knee. *Reimaries*, De Tumore Ligamentorum circa Artic. Leyd. 1557. *Stanley's* Cases of Injury to the Hip-joint, Medico-Chirurg. Trans. vol. xiii. *Syme*, On Excision of Diseased Joints. *Scott*, On Diseases of Joints. *Wickham*. On Diseases of Joints. *Velpeau*, Anatomie Chirurgicale. *Velpeau*, Médecine Opératoire.

(*John Blackburn.*)

ASCITES (from ἀσκὸς, literally 'a wine-skin;' metaphorically, 'the belly'), abdominal dropsy, a complaint belonging to the province of medical pathology. Surgical treatment is, however, frequently required for its cure; and all particulars relating to such treatment will be found under the head Paracentesis Abdominis.

ASPHYXIA, *apoplexia*, *suffocatio*, Lat.; *ἀσφυξία*, Gr.; *asphyxie*, Fr.; *Scheintod*, Ger.; *asfissia*, Ital.

By the word asphyxia is now generally understood a failure of the function of respiration, in consequence of which the other functions become arrested, and a state of the system induced which is correctly and familiarly known by the term *suspended animation*.

The derivation of asphyxia, therefore (*a*, and *σφύξις*, pulsus), which has reference to a failure of the heart's action, expresses but one of the many consequences that follow a suspension of the respiratory process, and does not imply the meaning attached to the word at present. The early writers used the term in its original acceptation, and of late it has been extended so as to include all varieties of suspended animation, such as proceed from lightning, gaseous poisons, and other agents known primarily to affect the brain and nervous system; the function of respiration being subsequently arrested. It has also been applied to that stage of malignant cholera which is marked by pulselessness and other symptoms of collapse. In *asphyxia*, however, the exciting cause, whatever it be, takes effect first on the lungs, the suspended function of which involves very rapidly those of the heart and brain; in *syncope* the exciting cause takes effect first on the heart, the suspended function of which extends instantly to those of the lungs and brain; and in *apoplexy* the exciting cause takes effect first on the brain, and involves, in an interval more or less prolonged, the functions of the lungs and heart.

Respiration is an essential function for the manifestations of life in all organized beings. By its influence a chemical interchange is effected between the nutritious fluid circulating within them and the atmospheric air by which they are surrounded. From the lowest vegetable production to man this chemical interchange has been observed; and in the higher orders of animals it cannot, for even a very short period, be put a stop to without the consequences being fatal. It is true that experiments have been made for the purpose of demonstrating that the respiratory function is not essential to the manifestations of life; and accordingly insects have been placed in vacuo and in irrespirable gases, and have been found to live for days. The fact, also, of worms supporting life in the alimentary canal has been adduced in confirmation of this opinion. But, even admitting in the first place the accuracy of the experiments alluded to, it by no means follows, because the vital manifestations of the beings experimented upon are not suspended even for days when thus deprived of the influence of the atmosphere, that respiration is not essential to their existence. Such experiments rather tend to prove the power those beings possess of supporting life, when thus unfavourably placed, *longer* than other animals in whom the organs of respiration are more centralized and more restricted to the performance of their special function. And when it is taken into account that a respiratory apparatus, on an extensive scale, exists in all insects, ramifying through their several delicate organs, thus bringing the air into close approximation with their tissues, and rendering at the same time their bodies specifically lighter; and that to this extensive respiratory apparatus the organs of circulation bear no proportion; it is a reasonable inference that the function of respiration is not only necessary to their continued manifestations of life, but that it is carried on in them with a degree of energy in full proportion to their wonderful activity. The accurate and interesting experiments of Mr. Newport on the temperature of insects, published in the Philosophical Transactions for 1837, show, that in an humble bee the number of respirations varied in one hour from one hundred and twenty to forty-six, in proportion to its excitement; and when confined in a limited quantity of atmospheric air a specimen of the same insect produced in an hour, whilst in a state of excitement, $\frac{1}{8}$ of a cubic inch of carbonic acid, and during the twenty-four hours of the succeeding day the animal evolved a quantity absolutely less. Neither does it follow that, because intestinal worms and other parasitic beings live, increase, and multiply within the hidden recesses of the living animals they inhabit, similar changes are not effected in their circulating fluids as in animals surrounded by the atmosphere. The vital fluids with which these creatures are in contact doubtless supply them with the means of carrying on the essential chemical object of respiration in a manner allied to the more perfect aquatic respiration of fishes.

Essential, then, as the function of respiration is to all living beings in a state of activity, it may, notwithstanding, be dispensed with altogether previously to the phenomena which indicate vital action taking place. Many instances are on record of seeds, eggs, and even some of the lower animals preserving, as it has been termed, their "latent life" for indefinite periods, without exercising any action on the surrounding atmosphere, and in some cases being altogether excluded from it. Professor Lindley records the following interesting account of seeds which retained their power of germinating for many centuries:—"I have now before me three plants of raspberries which have been raised in the gardens of the Horticultural Society from seeds taken from the stomach of a man whose skeleton was found thirty feet below the surface of the earth, at the bottom of a barrow which was opened near Dorchester. He had been buried with some coins of the Emperor Hadrian, and it is probable, therefore, that the seeds were sixteen or seventeen hundred years old." It is likewise recorded that some bulbs which were taken from the hand of a mummy found in one of the pyramids, and which had been immured between two and three thousand years, produced unknown plants when sowed in one of our botanic gardens. Even some animals may be reduced to a perfect state of inactivity, and their respiratory and circulatory functions may cease, but on again being called into the active state, these functions resume their wonted energy. Thus fishes after being frozen have manifested renewed animation when their natural element again became fluid; and in an interesting paper in the Dublin Journal of Medical Science, "On Latent Heat and Vital Crystallization," Dr. Greaves mentions a remarkable instance of "long *suspended animation* or latent life." Dr. Macbride, of Dublin, having one day opened a chest in his museum, for the purpose of *washing in warm water* snail shells it contained, was called away for a time, and on his return found the animals creeping about on the sides of the vessel: these shells had certainly been in the collection nearly forty years.

In man, however, and in the higher orders of animals, a total suspension of respiration for a short period is fatal. In animals which hybernate there is a great diminution, but never a total suspension of vital action; in the hamster the pulse usually beats at the rate of one hundred and fifty per minute; but it is reduced to fifteen in the torpid condition. Marmots in a state of health and activity perform about five hundred respirations in an hour; but in the torpid state these occur only about fourteen times during the same period, and are executed at intervals of four or five minutes of absolute rest, and without any considerable enlargement of the chest. The disuse of the locomotive powers obviously renders unnecessary those changes which are essential to the maintenance of their active condition; and the organic functions, therefore, need do no more than preserve the integrity of their structures[1].

There are some few well-authenticated instances of recovery from suspended animation after the respiratory and circulatory functions had ceased for an unusually long period. It is recorded in the reports of the Humane Society that a lady who died in Herefordshire was restored to life after interment by a thief who attempted to steal a valuable ring from her finger. The case of Margaret Dickson, who was executed at Edinburgh in 1727, is amongst the best-accredited instances of recovery from suspended animation produced by hanging. The remarkable case of Colonel Townsend has been frequently referred to in order to show the influence of the mind on the action of the heart, though the power which he possessed over it was evidently affected by changes produced in respiration. It is said that a few days before his death he could expire when he pleased, and by an effort he could come to life again! Before making the experiment on the day of his death his pulse was distinct, though small and thready, and his heart had the usual beating. He composed himself, and lay on his back in a still posture for some time. His pulse sank gradually, till at last it could not be felt by the nicest touch; not the least motion could be felt in the heart, *nor the least soil of breath perceived on a bright mirror held to his mouth;* not the least sign of life could be perceived. He continued thus for half an hour; the motion of the heart was then observed gradually to return, and he recovered again, executed some business, and died the same evening[1]! All these cases must be regarded as exceptions to the general law, and as depending upon causes which are probably beyond the reach of human investigation. They are, however, sufficient to guard us against pronouncing any person irrecoverably dead before indications of decomposition have occurred; and they also hold out inducements to persevere in our measures for restoring a person apparently dead under circumstances the most disheartening.

ORGANS OF RESPIRATION.

The fundamental part of the organs of respiration in animals is a membrane, situated in such a manner that the circulating nutritious fluid may be in contact with one of its surfaces and the atmospheric air with the other; so that by this approximation those chemical changes may be effected which are the object of the function. This, the most simple form of respiratory organ, presents many varieties, and receives many accessary parts, as we ascend in our examination of it in the higher classes; all of which varieties and additions are subservient to the vital manifestations the being is destined to exhibit, and the respiratory medium which it inhabits. In the lowest animals the skin is the only respiratory organ; in many this membrane is prolonged in the form of respiratory lamellæ and tufts. In the higher aquatic animals the respiratory apparatus assumes the form of gills, which are disposed in fringed laminæ, and attached at the posterior and lateral parts of the mouth to four or five bony or cartilaginous arches analogous to ribs. The heart is so related to these organs that all the blood enters them before being sent to the system at large; and by the connexion of the gills to the mouth streams of water containing air are constantly being propelled over their surface. In bony fishes the gills are protected by a valvular covering, called the operculum, which allows the water, after it has served the purposes of respiration, to escape at its posterior free margin. If one of these animals be secured to a line, and its head drawn *with* the stream, the opercula acting as valves will prevent the entrance of water in the retrograde direction to the gills; and death in this case, being produced by asphyxia, will much sooner occur than when the animal is killed by exhaustion, or by what has been called "playing it."

In reptiles, birds, and mammalia, the respiratory membrane is formed into hollow vesicular sacs, situated in the thorax, and communicating, by means of a trachea and larynx, with the pharynx, and through it with the nasal and oral cavities. The hollow respiratory vesicles in reptiles present many varieties. In some they are in the form of elongated sacs, as in serpents; in others, as the crocodile, they are subdivided, to a great degree of minuteness, by internal partitions. In birds and mammalia, whose vital manifestations are more dependent on the energy of the respiratory process, the air-cells are much more minutely subdivided, and the amount of surface over which the blood is exposed to the influence of the atmosphere is, in consequence, much greater than in reptiles. The lungs of birds, moreover, communicate with membranous sacs situated in the chest and abdomen, which again are prolonged into most of their hollow bones; so that in those birds whose bones are thus permeated by air, though the trachea be tied, the animal will still continue to respire by an opening made in the humerus.

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[1] Carpenter's Principles of General and Comparative Physiology.

[1] Wardrop on the Nature and Treatment of the Diseases of the Heart, 1837.

In man the organs of respiration consist of the lungs, which communicate with the atmospheric air by the trachea. Besides the subdivisions of this air-tube, they are also composed of the ramifications of the pulmonary artery, which carry to them, from the right heart, the venous or "black blood," to be brought into approximation with the atmospheric air; and of the ramifications of the pulmonary veins which return the arterialized blood from them to the left heart. In common with the other parts of the body, the lungs receive blood-vessels for their own support, nerves, lymphatics, and connecting cellular tissue. They are likewise covered with a serous envelope (the pleura), which is reflected from them on the inner aspect of the cavity in which they are contained (the thorax).

The thorax consists of active and passive agents of locomotion, by which the respiratory movements are effected, and its capacity alternately enlarged and diminished. The passive agents are the dorsal vertebræ, the ribs and sternum, and their connecting cartilages and ligaments. The active agents are the respiratory muscles destined for the elevation and depression of the ribs and sternum; a perfect muscular diaphragm, separating the thorax from the abdomen; the abdominal, and the sphincter, and the levatores ani muscles.

The lungs, although the sole agents for carrying out the essential chemical process of respiration, are so dependent on the respiratory cavity in which they are placed, that if its movements be suspended, the atmospheric air is no longer transmitted to the air-cells. Mayow not inaptly compared the respiratory organs to a pair of bellows, containing an empty bladder, the neck of which, by being adapted to that of the bellows, should admit air on drawing its sides asunder. But although this is the case as regards the lungs and thorax in the act of inspiration, the former following the latter in its movements, yet, in the act of expiration, the lungs themselves, by their elastic property, perform a part in the process. On the other hand, the respiratory muscles, for the due performance of their part in respiration, require a direct communication with the cerebro-spinal axis, and this is effected by the system of respiratory nerves.

In addition to a special apparatus for respiration, in most, if not in all animals, the skin also performs the part of a respiratory organ. After the discovery of the production of carbonic acid by the lungs, enquiries were instituted to ascertain whether the same occurrence did not take place at the surface of the body; the only difference between the approximation of the air and blood in the lungs and in the skin being the different thickness of the membrane by which they are separated. The experiments of Millet, Lavoisier, Jurine, Cruikshank, Abernethy, Ellis, Mackenzie, &c., go to prove that when air has been kept in contact with the skin, carbonic acid is generated; whilst Priestly, Klapp, and Gordon were unable to detect, in their experiments, the slightest change. Whether cutaneous respiration takes place or not in the human subject, the "vivifying influence" of the atmospheric air on the skin in the recovery of persons asphyxiated, is admitted on all hands, and will be again referred to in alluding to Edwards's enquiries.

CAUSES OF ASPHYXIA.

From the review just taken of the object of respiration, and of the organs by which the function is effected in man, it is obvious that asphyxia may be induced in a variety of ways, all of which, however, may be reduced to two general heads; 1st, causes which affect, directly or indirectly, the respiratory apparatus itself; and 2nd, causes which affect the air, so as to render it unfit when respired to carry out the essential chemical object of respiration.

In the first place, the mechanism of the thorax in relation to the bones and cartilages which enter into its formation, may be so interfered with as to impede or totally suspend its movements; the respiratory muscles destined to produce those movements being at the same time in a condition, as regards their integrity and their connexion with the cerebro-spinal axis, fitted to do so. Examples of suspending the actions of the thorax in this manner are furnished us by the modes of punishment some nations occasionally adopt towards their prisoners, by burying them up to the neck in earth firmly pressed around them. In these cases the pressure of the surrounding earth upon the thoracic parietes being greater than the respiratory muscles can overcome, the motions of the chest are suspended, the atmospheric air no longer enters the lungs, and asphyxia takes place. A black, from the fine form of his chest and well-marked muscles, had been selected as an academic model. It was wished to obtain a cast of his body; but this being attempted at one operation, and in one entire piece, as soon as the plaster began to set he felt on a sudden deprived of the power of respiration, and, to add to his misfortune, was cut off from the means of expressing his distress. His situation, however, was fortunately perceived just in time to save his life, by breaking his bonds and releasing him from the extreme peril in which they had placed him[1].

Secondly, the muscles of respiration may be paralyzed by their connexion with the cerebro-spinal axis being severed, as occurs when the spinal chord is divided or compressed above the attachment with it of the respiratory nerves. Or the muscles may be so injured by extensive wounds or disease as to incapacitate them from performing their actions.

Thirdly, the respiratory movements may be interfered with, and the lungs compressed, in consequence of collections of fluids, such as serum, pus, &c., taking place between the pleural envelopes of the lungs and thorax. (Vide EMPYEMA, HYDROTHORAX.)

Fourthly, the lungs, thorax, and respiratory muscles may be uninterfered with; but from causes which produce obliteration of the respiratory tube either by their acting of themselves, a strictly mechanical part, or by their presence producing spasm of the glottis, the access of air to the lungs may be prevented. Amongst the causes which induce asphyxia in this way may be enumerated all kinds of compression which operate externally upon the air-tube, such as strangulation, compression from tumours in the neck, or from foreign bodies impacted in the œsophagus; all foreign bodies received into its interior, and which fill its cavity; the effects of inflammation, as œdema of the glottis, the false membrane of croup or of chronic laryngitis, abscess of the glottis, fungous growths, submersion and the presence of non-respirable gases, or other causes which produce spasm of the glottis.

Fifthly, another class of causes may affect the ultimate ramifications of the bronchia, and interfere mechanically with the chemical end of respiration, by preventing the access of the inspired air to the blood, viz., effusions of fluid into the air-cells, the result of disease, or of division of the pneumo-gastric nerves.

The second class of causes which induce asphyxia by affecting the atmospheric air, consists of a too rarefied condition of this fluid, or the presence in it of certain gases. In both these cases the quantity of oxygen is not in due proportion in the respired medium, and the essential chemical object of respiration is therefore unattained.

If an animal be placed under the receiver of an air-pump, and the air be exhausted, or rather rarefied, it soon perishes; and if, during the performance of the experiment, air be re-admitted, it shortly revives. When an experiment of this kind is performed quickly, so as speedily to deprive the animal of the necessary supply of oxygen, death is speedily induced by asphyxia; but if it be slowly performed, or if the animal itself be allowed to respire the air it is confined in, it soon furnishes, in addition to the exhaustion of oxygen, a positively deleterious agent to the due performance of respiration, carbonic acid.

It is difficult to suppose a case of asphyxia occurring to man merely from an extremely rarefied condition of the atmosphere. It is even doubtful if the strange symptoms which travellers have experienced on reaching very high elevations are to be attributed to this cause, "producing a diminished pressure on the body," or to "an insufficient supply of oxygen for respiration." Boyle noticed the effects produced from ascending high mountains, and ascribed them to the rarefaction of the air. According to Haller, the peculiar sensations are to be attributed to excessive fatigue or exhaustion, rather than to any thing specifically depending upon the state of the air; and this opinion he supports from his own experience in his expeditions among the Alps, from the fact of individuals permanently residing in many parts of Switzerland at very considerable elevations without experiencing any inconvenience, and from effects of an analogous kind never having been noticed with respect to the different species of animals that are found in these regions. The account given by Saussure of the sensations he experienced at a very high elevation, and which he attributed to diminished pressure of the atmosphere upon the body, is not in accordance with that which other travellers have given us. "Respiration becomes laborious and panting, the pulse is quickened, and there is felt an universal uneasiness, joined to excessive weakness, and hæmorrhages come on[1]." Mr. Moorcroft informs us that when he was at the village of Niti, his breathing was quickened, and that he was obliged to *stop* frequently in consequence of the increased action of the heart; his breathing was often oppressed while he was lying down, and especially just before falling asleep. (Asiatic Researches.) The difficulty of breathing was also felt by Captain Webb when he visited Niti; and he adds, that horses are liable to it as well as men. (Quart. Journ.) Lieut. Gerard, who has ascended the Himalaya mountains to elevations of from fifteen to nineteen thousand feet, mentions that he suffered excessive debility and severe headache. (Geol. Trans.) Dr. Govan, who crossed the Himalayas at an elevation of considerably more than fifteen thousand feet, felt nothing peculiar in his respiration or other functions, nor was any of a train of forty natives who accompanied him in any way affected. (Brewster's Journal of Science.) Mr. Caldcleugh also, at an elevation of between twelve and thirteen thousand feet, seems to have experienced nothing more than what might reasonably be ascribed to fatigue; nor did any thing particular occur to his guides and attendants[2].

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[1] Roget, in Cyclopædia of Practical Medicine.

[1] Saussure, Voyage au Mont-Blanc. Richerand's Physiology, by Copland.

[2] Travels in South America. Bostock's Physiology.

"Some travellers who have ascended very high mountains have suffered much from rarity of the atmosphere near their summits. They have been unable to walk more than a few yards without stopping to take breath, and feeling extreme fatigue. This breathlessness has sometimes been accompanied by hæmorrhage from the lungs, sudden exhaustion of the muscular power, and fainting. These alarming symptoms are produced by the want of a sufficient supply of oxygen to the lungs, whilst at the same time the pressure of the atmosphere on the capillary vessels is diminished." (*Kay, on Asphyxia.*)

When such symptoms as those experienced by Saussure and others occur, they are much more likely to arise from excessive fatigue operating on a body unaccustomed to it, and admit of explanation on the principles of the musculo-cardiac and pulmo-cardiac functions[1]. In reaching those elevated situations the muscles are constantly and unusually exercised, and the quantity of arterial and venous blood within the cavities of the heart is, in consequence, increased, and hence "the pulse becomes quickened." The pulmo-cardiac function, by which the lungs regulate the supply of blood to the heart, so as to prevent congestion within the heart's cavities, is also more energetically called upon; and hence "the respiration becomes laborious and panting." In the balloon ascents which took place last year at the Vauxhall Gardens, individuals reached elevations greater than any already mentioned, without experiencing the least inconvenience; but the ascents to Mont-Blanc, &c., were accomplished by great muscular efforts, that in the balloon by none.

The gases which may be respired, and which cause asphyxia by their presence excluding the necessary supply of oxygen, are hydrogen and nitrogen, being of themselves otherwise uninjurious. The gases which are incapable of being respired in their pure state, and which asphyxiate by producing spasm of the glottis, are sulphurous acid gas, muriatic acid gas, nitrous acid gas, nitric oxide, ammoniacal gas, and chlorine. When these gases, however, are much diluted they may be respired; but they produce inflammation of the fauces and air-passages, or destroy life by acting on the texture of the lungs. Carbonic acid gas being the constant source of fatal accidents will be considered when treating of the varieties of asphyxia. Physiologists are not quite agreed as to its mode of action; some supposing it to be a positive poison, and others, simply an asphyxiating gas. The poisoning gases, such as sulphuretted hydrogen, carburetted hydrogen, &c., produce none of the symptoms of asphyxia. They act as poisons, and are received into the system in the same manner as the vapours of arsenic or hydrocyanic acid, when respired.

There are other gases also which are capable of being respired, but which do not asphyxiate, such as pure oxygen, and nitrous oxide. These, when they destroy life, kill by excitement, and consequently do not fall under our consideration at present.

GENERAL PHENOMENA OF ASPHYXIA.

When respiration is completely arrested for even a very short time, alarming symptoms supervene, and the effects are so speedily fatal, that it is difficult to note, with any degree of accuracy, their order of succession. The general phenomena, moreover, vary according as the quantity of oxygen in the respired medium is diminished, or is totally withdrawn. Some differences are also observed according to the means by which the supply is cut off.

In all cases of asphyxia certain general symptoms present themselves to us, and certain general appearances are revealed by the post-mortem examinations of bodies which have suffered death in this way.

When the access of oxygen is in any way prevented, the first effect perceived is an intense feeling of distress referred to the lungs; this is accompanied by a great desire to breathe, and by convulsive efforts of all the inspiratory muscles to expand the chest. This sensation becomes more and more insupportable; the animal gasps and makes use of all its efforts to gain a supply of atmospheric air, and the entire frame becomes agitated. These symptoms continue but for a short period before they are accompanied by vertigo and cerebral oppression, quickly followed by a torpor, which deprives the sufferer of all consciousness. Irregular and involuntary convulsive movements are exhibited in all the muscles; the face, and particularly the lips and eyelids, become livid and swollen; the eyes are suffused, and the surface generally becomes more dusky than the natural hue; the pulse is rapidly weakened, and soon ceases; the heart continues for a time feebly to propel the last scanty tide of black blood into the larger arteries; in a few moments its movements consist only of irregular contractions, until, at length, its action totally ceases, and all circulation is arrested. If asphyxia be induced slowly, the sufferings just enumerated are more protracted, and are accompanied with dizziness, singing in the ears, and confused vision.

Post-mortem appearances.—When the body is examined after death, its external surface exhibits a general lividity, from the imperfectly oxidized condition of the blood which is contained in the capillary vessels of the skin. The appearance of the countenance presents much variety; in some cases the eyes are distended and prominent, the pupils are dilated, and the features present an expression indicative of pain; whilst, in others, the features are calm and placid, and no swollen appearance of any part is presented. These differences of appearance exhibited in the countenances of individuals who have died from asphyxia induced by opposite causes, will account for some writers supposing the description which is given by Shakspeare of the frightful physiognomy of the Duke Humphrey as physiologically correct, and of others, of its being merely poetically so :

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[1] Wardrop on Diseases of the Heart. Lib. cit.

> "But see! his face is black, and full of blood ;
> His eye-balls farther out than when he lived,
> Staring full ghastly like a strangled man ;
> His hair upreared ; his nostrils stretched with struggling ;
> His hands abroad displayed, as one that grasped
> And tugged for life, and was by strength subdued."

The most remarkable appearances presented in the interior of the body are the following : there is a great accumulation of blood in the lungs, and these organs are sometimes so distended, that they forcibly protrude through the incisions made in the thorax for the purpose of exposing them ; the colour of the lungs is dark brown. On opening the trachea its mucous membrane is found injected with dark blood, and the intensity of the injection is greater as we trace the membrane towards the minute ramifications of the bronchia. The heart presents the coronary vein and its radicles distended with dark blood, as also its right auricle and ventricle, and the ascending and descending venæ cavæ, whilst the pulmonary veins, and the left auricle and ventricle, contain but a very small quantity of this fluid ; the latter cavities are in general found contracted. The viscera are congested with dark venous blood which escapes from them on being cut into, in consequence of its fluidity. The mucous membrane of the alimentary passages is also injected, and the larger papillæ, particularly those at the root of the tongue, are prominent. The sinuses and vessels of the brain are gorged with venous blood, and the cerebral substance, on being sliced, exhibits more than usually numerous dark red dots : sometimes there is an effusion of serum into the ventricles.

These appearances within the head, as well as those described of the countenance, will present more or less variety according to the method by which the asphyxia was induced, and to the length and violence of the struggle before total death occurred.

THEORY OF ASPHYXIA.

Previously to the discovery of the compound nature of the atmosphere, and of the changes produced in the blood by respiration, the several phenomena of asphyxia were accounted for on principles purely mechanical. The respiratory movements ceasing, it was supposed that the pulmonic circulation was arrested in consequence of the lungs themselves presenting an obstacle to the transmission of the blood through them ; in short, that the lungs, being no longer distended by the entrance of the atmospheric air, their air-cells became collapsed, their capillary vessels congested, and no blood being transmitted to the left heart, the systemic circulation was thus put a stop to. This theory, supported by Harvey and Haller, maintained its ground until 1788, when Goodwyn published his celebrated treatise, "On the Connexion of Life with Respiration," in which he refuted the opinion of Harvey and Haller, that in asphyxiated animals a mechanical impediment was offered by the lungs to the transmission of blood, and showed, that after air was once admitted into these organs, it could never again be sufficiently expelled to produce their supposed collapse, and that the quantity which remained after the fullest expiration was amply sufficient to distend the air-cells, and allow a free circulation of the blood in the vessels of their parietes. He thus overturned the theory of mechanical obstruction, and established another, which held its sway until the time of Bichat. Recognizing the importance of a supply of arterial blood for the due maintenance of the circulation, and seeing that when respiration was suspended the venous blood sent to the lungs was transmitted, unaltered in its qualities, to the left heart, Goodwyn supposed that this blood ceased to stimulate its cavities ; and in consequence of the left auricle and ventricle not being excited by their natural stimulant, arterial blood, they ceased to perform their wonted contractions, and thus the circulation was *here* primarily arrested. The theory of Goodwyn, as well as of those physiologists who went before him, was grappled with by the master mind of Bichat, and in its turn completely overthrown. Bichat showed, by a series of able experiments performed with his accustomed accuracy, that when an animal is asphyxiated, the venous blood is transmitted from the lungs into the left heart ; but that, instead of its not stimulating this organ, it had the very contrary effect, and was vigorously propelled by the left ventricle into the arteries, and thence into every tissue of the body. He demonstrated this in the following manner. Having adapted a tube, with a stop-cock, to the trachea of a dog, and having divided an artery, he closed the stop-cock, and thus prevented the further entrance of air to the lungs. At first the blood issued from the divided artery in a full stream, and was of a bright arterial colour ; but as the oxygen of the contained air in the lungs became exhausted, it gradually lost its arterial hue, acquiring a darker colour until it resembled venous blood : the blood after this continued for some time to be thrown out with its ordinary force, until, at length, the jet became smaller and weaker, and finally ceased. "I have seen," says Bichat, "a quantity of black blood discharged in this way, more than sufficient to kill the creature from hæmorrhage, were it not already dead in consequence of its asphyxiated condition." By this and other experiments Bichat showed that when the trachea of an animal was stopped so as completely to exclude the air, the venous blood continued to be sent in quantity and with force through the arteries for a time sufficient for it to permeate all the tissues of the organs. The theory of death by asphyxia, which was raised by Bichat on the foundation of these experiments, continued to be generally received as correct, until, by the later investigations of Dr. Williams, of Liverpool, and Dr. Kay, it was overthrown. Bichat held that the presence of black or venous blood in the organs was incompatible with the performance of their respective functions, and that especially the irritability of the brain and muscles soon perished under its poisonous influence. He injected into the carotid artery of a dog venous blood, and found that the creature appeared immediately to be agitated, breathed quickly, and seemed to be in a state of suffocation, similar to that of asphyxia. Its animal life became entirely extinct; the heart, however, continued to beat, and the circulation to go on for half an hour afterwards; at the end of which time the organic life ceased also. The same result followed when the blood taken from the arteries of an asphyxiated animal was injected into the carotid artery of another. From these experiments Bichat inferred that it was the presence of venous blood in the brain which produced the insensibility that so speedily supervenes in asphyxia, and that the suspension of the functions of all the organs connected with the cerebro-spinal axis necessarily followed this paralysis of the "cerebral powers." But in addition to this cause of the annihilation of the organs of animal life, in support of his doctrine he also contended, that the presence of the black blood in the muscles acted a prominent part; to prove which he injected the crural artery of an animal with the black blood taken from one of its veins, and shortly after the movements of the limb became enfeebled, and in other instances wholly paralyzed. In like manner the functions of the muscles of organic life became arrested, but at a later period than those of animal life; the heart continuing its action, poisoning, as it were, every organ. At length the function of the central member of the circulation itself becomes arrested; its coronary arteries become filled with black blood, and its structure penetrated with it; and suffering from the same cause in common with the other parts of the system, it dies. The main point of difference, then, between the theories of Goodwyn and Bichat lies in the former accounting for the arrest of the circulation, by supposing the action of the left heart to fail in consequence of not receiving arterial blood, its proper stimulus; and the latter contending that this arises from the heart itself, in common with the other organs, being penetrated by the deleterious black blood which eventually is fatal to its own action.

Two fatal objections to the theory of Bichat have been brought forward, and have been arrived at by actual experiment. The records of the Humane Society show that resuscitation, by the use of artificial respiration, has taken place after the individual operated upon had been submersed as long as fifteen minutes. And experiments performed on warm-blooded animals have likewise shown that resuscitation may be effected even after they have been immersed in water for seventeen minutes; and this at a time when the action of their heart must have ceased. If, then, the cessation of the heart's action arises, as Bichat supposes, from its structure being penetrated by venous blood sent to it by its coronary arteries, it is impossible to conceive how that action could be again restored by arterializing the blood of the capillary vessels of the lungs. Post-mortem examinations also of animals who have died from asphyxia, reveal that the cavities of the right heart and the lungs are distended with dark blood, whilst the cavities of the left heart are comparatively empty; a condition of parts which is evidently at variance with Bichat's views; for the left cavities should also be found distended, inasmuch as the dark blood continues to be sent to them, even to the heart's own destruction.

The researches of Drs. Williams, Kay, and Edwards, have fully proved that many of the views of Bichat have been too incautiously received; and Dr. Kay has embodied his views on the physiology, pathology, and treatment of asphyxia, in a volume specially devoted to that object. Dr. Kay views the organs of the body as being composed of a congeries of small blood-vessels, denominated, from their minuteness, capillaries. These vessels are possessed of peculiar powers, by which, in a healthy state, they only admit fluids of a certain quality, and exclude those which are incompatible with the functions of the part. They even resist the forcible introduction of other fluids, when injected with a syringe. In the lungs minute blood-vessels exist in an exquisitely delicate net-work; in these vessels the venous blood is exposed to the influence of atmospheric air; its qualities are changed; it loses its dark hue; and acquires a bright red colour; and hence Dr. Kay thinks it probable that the vessels in which the arterial blood circulates must differ, in their peculiar sensibilities, from those which propel the venous blood. He further conceives, that the laws generally observed to regulate the action of the small vessels in other structures, would be violated if the vessels which usually convey arterial blood were also able to convey with equal facility venous blood, in every state of its changes, until it acquires its darkest colour. When air is no longer inspired, a considerable quantity of this fluid remains in the ultimate bronchial subdivisions; and as long as this air contains a certain proportion of oxygen, the blood still undergoes its proper change in the pulmonary vessels, and the circulation proceeds with its ordinary activity; but as the proportion of oxygen diminishes, the blood ceases to acquire the bright vermillion colour, and becomes gradually darker, and the circulation progressively feebler and slower, "until when venous blood enters those vessels which formerly contained arterial blood only, this degenerated fluid is no longer able to excite their action, and the circulation stagnates in the structure of the lungs. The pulmonary veins then discharge their last meagre supply through the left auricle into the left ventricle, which propels its last and feeblest tide into the arteries, in which the circulation has, every moment, become more scanty, until the pulsation has gradually been extinguished." In support of his views Dr. Kay adduces one of Bichat's own experiments. "If a stop-cock be adapted to the trachea exposed and divided, and afterwards be shut, the blood becomes darker, and springs for some time with its usual force" from a divided artery; "but at length the jet becomes feebler; *re-admit the air*, the blood becomes almost immediately red, and its saltus rapidly increases." "In this experiment," observes Dr. Kay, "the exclusion of air is not continued so long as to produce a perfect abstraction of the oxygen remaining in the air-cells, when the stop-cock is closed; nor to extinguish the respiratory powers, the manifestation of which is resumed as soon as the stop-cock is re-opened. The blood, changed in colour, but not yet so much impaired in its qualities as to be unable to traverse the lungs, still circulates, and air is admitted at a moment when the danger of the occurrence of asphyxia is imminent; but when the respiratory powers and the organic functions are still supported by a blood partially oxygenated."

But in addition to the experiment of Bichat referred to, Dr. Kay performed others in further corroboration of his theory. He asphyxiated animals (rabbits and hares) by tying the trachea, and then opened a large artery, as the external iliac artery or the aorta. At the end of the second minute from the commencement of the experiment, when the external iliac artery was divided, a considerable quantity of dark blood flowed; but at the third minute it had almost ceased to escape. The heart continued to contract vigorously, and very small quantities of dark blood were observed to collect slowly every twenty seconds at the extremity of the artery; and although at the end of five minutes all flow of blood entirely ceased, the left heart continued to contract spontaneously for a very considerable period longer. When the aorta was divided no blood flowed from it after three minutes and a half, but the heart continued vigorous the usual period.

From these experiments Dr. Kay concludes that when the conversion of venous into arterial blood is prevented by excluding the atmospheric air, the blood gradually ceases to circulate in the capillary vessels of the lungs, in consequence of its being so changed as to fail in exciting the action of the vessels of arterial blood; the cavities of the left heart consequently receive a smaller quantity of blood, which is expelled for a time vigorously into the arteries. The ventricle, meanwhile, diminishes in size as the quantity of blood supplied becomes less, until, at length, although spontaneous contractions still occur in its fibres, no blood issues from a divided artery, and the ventricle, by contraction, has obliterated its cavity. After this, blood slowly accumulates in the auricle from the large vessels of the lungs, and its contractility continues for a very considerable period. In opposition, then, to the theory of Bichat and of Goodwyn, Kay argues with Harvey and Haller, in supposing the circulation in asphyxia to be primarily arrested in the lungs; but he does not suppose, with them, that this occurs from a mere collapse of the air-cells, or from a reflection of the vessels of the lungs on themselves offering a mechanical impediment to its transmission, but in consequence of the degenerated venous blood being insufficient to excite those pulmonary capillary vessels, whose natural stimulant is arterial blood.

In our account of Bichat's theory we have seen that he considered the presence of "black or venous blood in the organs to be incompatible with the performance of their respective functions, and that especially the irritability of the brain and muscles soon perished under its poisonous influence." Dr. Kay, however, conceives that dark blood from the left heart has no positively noxious influence on the muscles, but that its presence supports their contractile power for a considerable period. To prove this he secured three rabbits, and opened the abdomen of each; he tied the aorta of one above the renal arteries, and also the left common iliac close to the aorta. In eight minutes he opened the vena cava of the second, and the blood which immediately flowed he injected into the aorta of the first, and found the contractility of both extremities to be equally vigorous. At the fourteenth minute the degree of contractility having been ascertained by the insertion of needles attached to the wires of a galvanic battery, he injected another quantity of blood, and he found no difference in the contractility of the muscles in the two extremities. He then injected, in the course of thirty minutes, venous blood obtained from the cava of the third rabbit, and at each interval between the injections the wires were equally applied to the muscles of both extremities, and their contractility gradually and equally declined in each, as in experiments in which the artery is simply tied. Anxious, however, to compare the effect in the muscles, and with the blood of the same animal, *cæteris paribus*, he performed the following experiment:—The trachea of a rabbit was laid bare, a ligature was passed beneath it, and one also beneath the abdominal aorta, above the superior mesenteric artery. The aorta and trachea were tied nearly at the same moment; the muscles continued equally vigorous for some time on the application of the wires of the battery; they then equally and gradually decreased in strength, and in one hour ceased, contracting to the stimulus at the same time; the muscle of the upper extremity appearing, towards the close of the experiment, to be somewhat stronger. From these and other experiments Dr. Kay infers, that dark blood from the left heart has no positively noxious influence on the muscles, and that its presence in the voluntary muscles supports their contractile power for a considerable period. (*Kay*, 182.)

The effect of venous blood on the brain and nervous system has also been made the subject of inquiry by Dr. Kay, and various experiments which he has performed incline him to question even this part of Bichat's doctrine. He found that venous blood from one rabbit could be injected slowly and cautiously, so as to avoid all injury of the cerebral matter, into the carotid arteries of another, without causing more than muscular debility and lassitude ; and from this he concludes that venous blood is only a weaker stimulus to the brain than arterial, and that the functions of this organ cease in asphyxia, because the circulation being arrested in the lungs, the diminished quantity sent to the brain is insufficient for its functions.

The general conclusion, then, which Dr. Kay deduces from all his investigations are, *First*, that the circulation is arrested after respiration ceases, because, from the exclusion of oxygen, and the consequent non-arterialization of the blood, the minute pulmonary vessels, which usually convey arterial blood, are then incapable of conveying venous blood, which therefore stagnates in the lungs. *Secondly*, that the arrest of the circulation is sudden when the lungs are entirely deprived of air, and that blood ceases to flow from them into the left cavities of the heart, even in the smallest quantities, in about three minutes and a half. *Thirdly*, that even supposing a great quantity of venous blood was transmitted through the lungs, it would not impair their contractility ; but, on the contrary, it is even capable of supporting this power for a certain period. *Fourthly*, that venous blood does not possess any noxious quality, by which the organic functions of these tissues can be destroyed, but is simply a less nutritious and less stimulating fluid than arterial blood ; and *lastly*, that the functions of the muscular fibre cease in asphyxia, because the circulation, and consequently the supply of the fluid which is necessary to life, is arrested in the lungs.

Of the different theories just enumerated, that proposed by Dr. Kay has received the most general assent of physiologists ; except in that portion of it which relates to the cause of the stagnation of the blood in the venous capillaries of the lungs.

In the natural condition of the lungs, the circulation is carried on in those organs as in other parts of the body by arteries and veins; but here the arteries convey to them the venous blood, delivered by the right heart, and the same blood after being arterialized, is carried by the veins to the left heart. The venous blood in the lungs has been looked upon in consequence, as the natural stimulant to the capillary ramifications of the pulmonary artery, and the arterial blood as the natural stimulant to the capillary ramifications of the pulmonary veins.

We have seen that Dr. Kay thinks it probable, that the vessels in which the arterial blood circulates, must differ in their peculiar sensibilities from those which propel the venous blood, and that when venous blood enters those vessels which formerly conveyed arterial blood only, this degenerated fluid is no longer able to excite their action, and the circulation stagnates in the structure of the lungs.

But we very much question how far this explanation of the cause why the non-transmission of the venous blood through the capillaries of the pulmonary veins is correct ; particularly when it is remembered, that after respiration has been arrested, the right heart continues so long to send with force the blood to the lungs. And, moreover, Dr. Kay himself agrees not merely with Bichat, in opposition to Goodwyn, that venous blood stimulates the left heart ; but in opposition to Bichat's own theory, has shown by experiment, that it is capable of exciting instead of destroying the contractility of the muscles ; and if cautiously and slowly injected through the carotids, of even stimulating the brain, though in a weaker degree than arterial blood.

This then being the case, as regards the action of venous blood in other organs of the body, it is a fair presumption, that in the lungs its presence is a sufficient stimulus to those capillaries, which in the natural process of respiration convey arterial blood ; and if so, some other cause to account for the stagnation of the blood in these vessels must be looked for, besides the degeneration of this fluid rendering it an insufficient stimulus to the capillary ramifications of the pulmonary veins.

On this question Dr. Alison, whose opinion on all questions in physiology is deserving of much respect, observes, " the stimulus to the circulation which is given by the arterialization of the blood, which we have found to act chiefly in the capillaries of the lungs, is of the nature of an *attraction* of the venous blood, towards the part where it is to undergo this change, and towards the arterial blood in advance of it in the vessels ; not of the nature of an increased contraction of the vessels themselves ; and that it is in consequence of the failure of this *auxiliary power* in the circulation, that the stagnation of the blood in the lungs in asphyxia, and the extinction of the organic life, are effected."

This theory Dr. Alison arrives at, from a consideration of the powers which move the blood and other organized fluids in living animals, independently of any contractions of moving solids, such as the flow of blood to the mucous membrane of the stomach and bowels during digestion, to the uterus during gestation, and to any part of the body during inflammation. All which movements of the fluids, to a certain degree, are caused to be directed towards the part, where the power of digestion, &c. resides, by any stimulus given to such act of nutrition or secretion, although applied at the extremity of the capillaries, producing "an effect on the circulation which, as Sir C. Bell expresses it, is *retrograde along the branches* of the arteries :"—from the analogous movements of the fluids of vegetables which are offered on the application of heat, or other stimuli, to one of their branches or roots, in the absence of any evidence, to show the existence either of a structure or of a contractile power in the vessels or cells, through which the fluids pass, capable of giving them a determinate direction towards the parts which are thus stimulated :—from the fact, that the conversion of venous blood into arterial, which takes place in the lungs, is accompanied with an increase of fibrin in the latter, and also an increased tendency to coagulation, "which implies such an increase of an attraction of aggregation in the particles of the fibrin, as may be held to be strictly vital ;" and that, on the contrary, a change from arterial to venous blood is accompanied with a separation of the globules of the latter, its whole bulk appearing somewhat increased ; and also from the derivation of blood in all directions, which takes place towards an opening, when made in a vessel of a living animal.

Dr. Alison, moreover, insists, that we have no distinct evidence of the existence of coats, still less of irritable coats, in the minute capillaries of the lungs, and that the only vital power of contraction, which experiments authorize us to ascribe to any arteries, is a power of permanent or tonic contraction on their contents, which, when called into action, lasts for some time, and must impede the flow of fluids through them ; that the only powers arteries possess over their contents, according to Majendie and other eminent physiologists, is simply one of contraction, so as to lessen or retard their flow, and one of relaxation, so as to give them a free passage ; and that, conformably with these views, Wedemeyer found stimulating liquids when injected into the arteries of a living animal, were much longer in making their way into the veins than mild ones[1].

The difference then, on the question under our present discussion, between the theory of Dr. Kay and of Dr. Alison, is simply this. Dr. Kay supposes, when an animal is asphyxiated, the arrest of the circulation in the capillary ramifications of the pulmonary arteries and veins, arises from *a cause* which is to be referred to the capillaries themselves ; these vessels failing in their action, from the want of their proper stimulus, or in Dr. Kay's own words, "the minute pulmonary vessels which usually convey arterial blood are incapable of conveying venous blood, which therefore stagnates in the lungs[2]." Whilst Dr. Alison, for the reasons already so largely quoted, attributes *the cause* of the stagnation of blood, not to "the nature of an increased contraction of the vessels themselves," but to a failure of that "auxiliary power" in the pulmonic circulation, which is "of the nature of an *attraction* of the venous blood towards the part where it is to undergo the change into arterial blood ;" the power itself inducing this *attraction* being the process of arterialization ; to the accomplishing of which process, the admission of pure air to the lungs is essential, but which admission in asphyxia is prevented.

It too often happens in physiology as in other sciences, that when any new theory is propounded, those which preceded it are either altogether lost sight of, or are merely mentioned as matters of history.

The theory of digestion, which at one time was solely a concoction, at another a fermentation—a nervous function—a chemical solution—a vital principle, and so on—is an example of what has happened in this way ; not to mention the history of animal heat, absorption, the seat of vision, and, indeed, every observed function of the human body. All these "have had their day," as the common expression goes ; and when the imagination, at first raised and dazzled by the new doctrine, subsides, and judgment resumes her seat, the older opinions, when again examined, are found, if not perfect, at all events, of some assistance in helping to explain the subject under enquiry, or in accounting for many of its phenomena.

The older physiologists, including Harvey and Haller, as we have already seen, looked upon the stagnation of blood in the capillaries of the lungs in asphyxia, to be caused by the suspension of the movements of the thorax. Goodwyn showed, that after these movements ceased, dark blood was for a short time sent to the left heart. Bichat, in rejecting Goodwyn's own theory of the non-exciting power of this blood to the ventricle, although he sneers at the idea of angles of vessels, and collapsed air-cells offering any impediment to the passage of the blood through the lungs ; yet details an experiment admirably calculated to show the instantaneous effect of the respiratory movements in facilitating the passage of this fluid.

If a stop-cock be adapted to the trachea, and an artery opened, the blood will blacken, and continue for some time to be thrown out with its ordinary force ; but at last the jet will gradually grow weaker. If after this the air be admitted, the blood will almost *immediately* become red, and its jet visibly *augmented;* and Bichat further observes, that this *impetuosity* depends on the *movements of respiration*, to which the animal is obliged on the admission of air. "Besides, the influence of a series of full respirations may be manifested without dividing the trachea ; open the carotid artery, and hurry the respiration of the animal by tormenting it (for pain will constantly have this effect), and the jet will be visibly increased." These observations, although made to account for "why the *heart* ceases to act when the chemical functions of the lungs are interrupted," bear much more strongly in demonstrating the effects of the respiratory *movements* on the pulmonary circulation. And it is strange that Bichat should have added, that in the ordinary state of health, "a series of strong expirations will not be found to quicken the pulse."

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[1] Cyclopædia of Anatomy and Physiology.

[2] Kay on Asphyxia, p. 181.

In considering all these different theories, it appears to us that much more is to be attributed to the effects of the mechanical movements of the thorax, in carrying out the pulmonary circulation, than seems willing to be conceded.

When the fœtus makes its first inspiration, the expansion of the thorax carries with it the subservient lungs, and two new currents are immediately established in these organs; one a current of air by the trachea, the other a current of blood by the pulmonary arteries; and which latter current is diverted towards the respiratory organs by their expansion, otherwise it would move as before through the ductus arteriosus. This first respiratory movement acts strictly a mechanical part in bringing the two currents towards each other, and such being the case, the auxiliary power of Dr. Alison does not in this case exist, because the flow of blood to the air-cells is accomplished contemporaneously with the flow of atmospheric air.

In after life, the regular succession of the involuntary respiratory movements is admitted, on all sides, to be most remarkable and difficult of explanation. "The increase of the blood's impulse by expiration is in many persons so great, that the pulse at the radial artery becomes imperceptible when inspiration is long continued, and the breath held. This is the case with myself, and it in some measure explains the fable, of persons possessing the power of altering the actions of their heart at will[1]."

The condition of the blood in the collapsed stage of malignant cholera, its dark character, and its extreme thickness from the loss of its serum, must offer great difficulty to its transmission through the lungs; yet we know this to be accomplished, as is evidenced by the feeble pulse which is detected in the larger arteries; and as the chemical changes of respiration are here nearly, if not wholly suspended, the transmission of the blood must be entirely dependent on the respiratory movements, which are performed with a gasping effort. When powerful emetics have been administered in this condition of the system, and when they have succeeded in producing vomiting, we have repeatedly observed the pulse return for a short time in the smaller arteries; which stimulus to the circulation was doubtless effected by the respiratory movements which accompany this action.

Before we enter upon the consideration of the general treatment of asphyxia, it is necessary to notice briefly the interesting researches of Dr. Edwards[2].

The first inquiry of Dr. Edwards we shall notice, is that which relates to the comparative influence of air and water upon the nervous and muscular systems,—a question, as Dr. Kay justly remarks, of grave importance, when considered as affecting the treatment of asphyxia. The singular power possessed by reptiles, of living a considerable time after the excision of the heart, afforded Dr. Edwards a means by which the respective influence of air and water could be appreciated. By the removal of the heart, the circulation of the blood, and, as a necessary consequence, respiration, are annihilated. A part of the blood escapes; and that portion which remains may be regarded as a constituent part of the organs. The nervous and muscular systems alone are left, and these are inseparably connected. If, after having cut out the hearts of reptiles, taking care to remove also the bulb of the aorta, an equal number be placed in air, and in water deprived of air, the difference in the duration of life, if any difference exist under these two circumstances, will indicate the respective influence of these media on the nervous and muscular systems, independently of that which it may exert on the circulation and respiration.

Dr. Edwards removed the heart and bulb of the aorta from four salamanders; he exposed two of these to the air, and immersed two others in water of the same temperature, which had been deprived of air by boiling. In about four or five hours the salamanders in water appeared dead; but that life still existed was rendered evident, when they were moved or pinched. One died in eight hours, the other in nine. Those in air, however, lived from twenty-four to twenty-six hours. These experiments he repeated with the same precautions, upon six other salamanders, and obtained similar results; hence he inferred, that air, in comparison with water, has a superior vivifying influence upon the system of these animals, independent of its action by means of circulation and respiration. Similar experiments were also performed on frogs, six of which were placed in air, and six in water deprived of air. Those in water lived two hours, those in air three; and their activity, which continued to be considerable after the excision of the heart, decreased much more rapidly in the water than in the air, and stimulation produced much less effect.

What confirms, however, in the most striking manner, the vivifying effect of air, and the deleterious effect of water on the nervous system, is the following. If a frog, deprived of its heart and immersed in water, be drawn out and exposed to the air, at the moment when all signs of life have disappeared, it immediately begins to recover. If it again be plunged in water, all appearance of life instantly ceases; and it may thus be made several times alternately to lose and recover its motion and sensibility.

In order to determine the influence of the circulation of venous blood on the nervous system, frogs, whose hearts had been removed, and an equal number of these animals uninjured, were placed in vessels containing water deprived of air. The frogs in which the action of the heart and the circulation continued, always survived the others a considerable period, and sometimes above twenty-four hours. Similar results were obtained with toads and salamanders. Hence Dr. Edwards concludes, that the circulation, even of venous blood, is favourable to the action of the nervous and muscular systems, though incapable of maintaining life beyond a very limited period.

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[1] Müller's Physiology, by Baly.

[2] Influence des agens physiques sur la vie.

Lest it might be presumed that the water, in which the animals were immersed in these latter experiments, exerted a deleterious influence on their nervous and muscular systems, preventing the venous blood from prolonging life so much as it would have done in a less noxious medium, Dr. Edwards performed the following experiment.

He strangled six frogs, by tying very tightly, with a packthread round the neck, a piece of bladder fitted very closely to the head, so as to exclude the air; the ligature itself being sufficiently tight to effect this. At first the frogs were paralysed; but they afterwards to a great degree recovered, and lived from one to five days; while the same number in water were dead in ten or twelve hours. The same experiment on salamanders was attended with similar results, and one of these animals lived twelve days, until its head became gangrenous from the effects of the ligature.

The marked difference also which exists in the duration of life in animals strangled, and in those immersed in water, shows, that in the former, life is supported many days without any other action of the air, than that which may be exerted on the nervous system, or on the blood through the medium of the skin. To demonstrate the influence of the air on the blood, through the medium of the skin, frogs strangled with bladder and a ligature, as in the preceding experiments, were placed in receivers containing atmospheric air. They were removed an hour or two after, and a sensible quantity of carbonic acid was detected in the air of the vessels.

Dr. Edwards' next inquiry was, how far the facts just detailed may be modified by various circumstances; and further experiments warranted him in concluding, that as the *temperature* of the water, in which the animals are immersed, is reduced, so will the duration of life be prolonged. Thus when the temperature of the Seine water was cooled by means of ice to 50° Fahrenheit, it was found, that of two frogs immersed in it, one lived five hours fifty minutes, and the other six hours fifteen minutes. When the water was reduced to 32° Fahrenheit, eight frogs were introduced into it, and they lived from six hours seven minutes to eight hours eighteen minutes. When, instead of cooling the water, its temperature was raised to 72° Fahrenheit, that of the air being 68° Fahrenheit, the frogs only lived from one hour ten minutes to thirty-five minutes; when it was raised to 90° Fahrenheit, they died in from thirty-two minutes to twelve minutes; and when it was raised to 108° Fahrenheit, they scarcely lived a few seconds, and in no instance exceeded two minutes. It is worthy of remark, that the degree of heat at which frogs cannot survive immersion in water is about the natural temperature of warm-blooded animals.

The influence of temperature on fishes, he also found to resemble that on the Batrachians. If a bleak (*cyprinus alburnus*) be put into a vessel with a large mouth, containing five ounces and a half of aerated water at 68° Fahrenheit in summer, it dies within a few hours; but when the temperature is lowered to 50° or 53° Fahrenheit, and kept at that point, the animals lives until its secretions are so abundant as to corrupt the water.

The general result to be arrived at from these facts is, that, notwithstanding the different conditions in which the animals are placed, the more the temperature is raised beyond certain limits, the greater is the degree of the influence of the air required for the support of their life.

Dr. Edwards' experiments on warm-blooded animals are also full of interest, and bear even more directly on our present inquiry.

In consequence of the circulation being more rapid, and the nutritive function more active in young animals, it has been a general opinion that their temperature is much higher than in adults; but the contrary is the fact. A thermometer being placed in the axilla, and the bulb applied so as to be on all sides in contact with the animal, it was ascertained that the temperature of some new-born puppies whilst in the act of sucking was nearly equal to that of the mother, being about a degree or two lower; this difference not being constant, and being observable among adults also, it may be altogether disregarded.

When, however, at a temperature between 50° and 68° Fahrenheit, a new-born puppy was removed, and kept an hour or two from its mother, its temperature fell considerably, and continued falling, until, in the course of three or four hours, it stopped a very few degrees above that of the surrounding air. The same phenomenon took place with kittens and rabbits.

The effect of these experiments was ascertained not to be occasioned by the want of food, for the temperature began to fall as soon as the separation from the mother took place, and the diminution was not in the least retarded by furnishing the young animal with milk from time to time. Neither can it be attributed to the want of an artificial covering, which could only retard and not prevent the lowering of the temperature; and in some animals well covered with hair at birth, exposure, though more slowly, produces the same effect.

It appears, then, the young animal produces less heat in a given time than the adult; and as it advances in life, that it gradually acquires a greater power of producing heat, until at the end of a fortnight it enjoys this faculty equally with its parent.

The young of the mammalia, however, are to be distinguished into two classes, in relation to the production of animal heat. Some are born, as it were, cold-blooded : others warm-blooded. Corresponding with this difference, a distinction is deducible from the state of the eyes. Some are born with their eyes closed, others with the eyes open. The temperature of the former rises successively, and at the end of a fortnight (which is the period when the eyes open) it is nearly equal to that of adults. Thus the state of the eyes, though having no immediate connection with the production of heat, may yet coincide with an internal structure influencing that function, and certainly furnishes signs which serve to indicate a remarkable change in this respect, since, at the period of the opening of their eyes, all young mammalia have nearlythe same temperature as adults.

The young of birds are also to be divided into two classes. Some when hatched can eat and run, and are only covered with a tolerably thick down, and this class can maintain a moderately elevated temperature, if exposed to the air in a favourable season. Another class is born without down or feathers, is incapable of providing for itself, and is in a similar condition in relation to the production of heat with cold-blooded animals. Young birds, however, require a degree of heat equal to that of adults of the same species, and which neither the mild warmth of spring nor the strong heat of summer can supply. The temperature of this class is preserved by the shelter of their nests, their mutual contact, and the assiduous care of their parents, who impart the warmth of their own bodies to them during all the time that is not occupied in obtaining food; but when separated from each other, and exposed to the atmosphere, they rapidly cool down to within one or two degrees of the temperature of the air.

It is from within alone that animal heat can originate, however outward coverings may contribute to retard its dissipation. Accordingly an adult sparrow stripped of its feathers, cutting them so as completely to expose the skin, preserved the temperature which it had before the experiment, being 36° Fahrenheit above that of the atmosphere, which was at 64°; whilst, on the contrary, young birds of the same species, taken from their nest, where they had a suitable degree of warmth, and which the feathers they had begun to acquire, tended to preserve, cooled down to within one or two degrees of the external air.

From these and similar facts, it appears that the power of producing heat in warm-blooded animals is at its minimum at birth, and increases uniformly until adult age.

The duration of life, when animals are deprived of air, extends to every age, in the opinion of Dr. Edwards, and should serve as a strong reason for not rashly applying a high external temperature, for the restoration of persons from a state of suspended animation.

From further experiments of Legallois and Edwards, there appears to be an intimate relation between heat and respiration in both cold-blooded and warm-blooded animals. The dividing of the eighth pair of nerves produces, along with other phenomena, a considerable diminution in the opening of the glottis, so that in puppies recently born, or one or two days old, so little air enters the lungs, that when the experiment is made in ordinary circumstances, the animal perishes as quickly as if it were entirely deprived of air; it lives about half an hour. But if the same operation be performed upon puppies of the same age benumbed with cold, they will live a whole day. In the first case the small quantity of air is insufficient to counteract the effect of the heat, but in the other it is sufficient to prolong life considerably. (*Edwards, Lib. cit.*)

GENERAL TREATMENT OF ASPHYXIA.

Having seen that Asphyxia may be induced in a variety of ways, the first object of the practitioner must evidently be directed to the removal of the individual from the continued influence of the exciting cause, and the second to the re-establishment of the respiratory functions of the circulation, and of the functions of the brain and nervous system.

Temperature. — The researches of Dr. Edwards, which we have just quoted, are calculated to throw great light on the importance of attending to the degree of temperature to which the asphyxiated should be subjected, as well as the quantity and kind of covering which should be placed upon the body before attempting to make use of other restoratory measures.

The practical inferences applicable to adult age, and particularly to man, which he deduces from his experiments, are the following :— A person is asphyxiated by an excessive quantity of carbonic acid, in the air which he breathes; the beating of the pulse is no longer sensible, the respiratory movements are not seen, his temperature however is still elevated. How should we act to recal life? Although the action of the respiratory organs is no longer visible, all communication with the air is not cut off. The air is in contact with the skin, upon which it exerts a vivifying influence; it is also in contact with the lungs, in which it is renewed by the agitation which is constantly taking place in the atmosphere, and by the heat of the body which rarefies it. The heart continues to beat, and maintains a certain degree of circulation, although not perceptible by the pulse. The temperature of the body is too high to allow the feeble respiration to produce upon the system all the effect of which it is susceptible. The temperature must then be reduced, the patient must be withdrawn from the deleterious atmosphere, stripped of his clothes, that the air may have a more extended action upon his skin, exposed to the cold, although it be winter, and cold water thrown upon his face until the respiratory movements reappear. This is precisely the treatment adopted in practice to revive an individual in a state of asphyxia. If, instead of cold, continued warmth were to be applied, it would be one of the most effectual means of extinguishing life. This consequence, like the former, is confirmed by experience.

In sudden faintings, when the pulse is weak or imperceptible, the action of the respiratory organs diminished, and sensation and voluntary motion suspended, persons the most ignorant of medicine are aware that means of refrigeration must be employed, such as exposure to air, ventilation, sprinkling with cold water. The efficacy of this plan of treatment is explained on the principle before laid down.

Likewise in violent attacks of asthma, when the extent of respiration is so reduced that the patient experiences suffocation, he courts the cold even in the most severe weather; he opens the windows, breathes a frosty air, and finds himself relieved.

Admitting then the correctness of Dr. Edwards' views, of which there can be little doubt, the directions which have been given by the Royal Humane Society for the recovery of persons apparently dead, are liable to objections; first, in regard to the temperature recommended, and, secondly, to the re-clothing and otherwise enveloping the body. On these points the following directions have been given :—" While some assistants are engaged with artificial respiration, others, we have already hinted, should be employed in communicating continued heat to the body. Dry warm blankets, bags of warm grains, or sand bladders, or bottles of hot water, or hot bricks, or hot blankets, wrung out of hot water, are amongst the means most easily obtained. The body may be placed before a fire, or in the sunshine, if strong at the time. Whatever may be the means employed, the restoration of warmth should always be arduously pursued. Should the accident happen in the neighbourhood of a steam-engine, brew-house, bake-house, or any fabric where warm water may be easily procured, it would be of great importance to place the body in a warm bath, moderated to a degree of heat not exceeding one hundred degrees. The warmth most promising of success is that of a heated bed or blankets. Bottles of hot water should be laid at the bottoms of the feet, to the joints of the knees, and under the arm-pits; and a warming-pan, moderately heated, or hot bricks wrapped in cloths, should be passed over the body, and particularly in the direction of the spine. A large bladder should be applied, filled with hot water, and inclosed in flannel, to the region of the stomach and heart. The natural and kindly warmth of a healthy person, lying by the side of the body, has been found in some cases of adults, and particularly of children, very efficacious; but the warm bath, where it can be procured, is preferable to all other means of communicating heat."—*Royal Humane Society's Report*, 1833, p. 100.

Were the directions here recommended to be implicitly obeyed, the enfeebled vital actions would be in danger of extinction, and the " apparent death" would soon become real. The temperature of the apartment in which the body is laid, should in general not be higher than 75° or 80°; and Dr. Edwards even recommends in some cases that it should be lower than this. The advantage to be derived from exposing the surface of the body to the vivifying influence of the air is altogether lost sight of, when the body is recommended to be "re-clothed," "to be wrapt in blankets wrung out with hot water," or to be immersed in a " warm bath." Where heat is demanded, its application is therefore preferable in the radiant form, and when *conducted* heat is called for, it should be so partial in its application, as to interfere but little with the exposure of the surface to the " vivifying influence" of the air. The employment of heat in the radiant form also gives us the opportunity of applying friction and other excitants to the body, and does not interfere with our endeavours to restore life by artificial respiration.

The body should therefore be placed before the fire, or in the sunshine, and bottles of warm water, or warm bricks, applied to limited portions of the cutaneous surface, such as the soles of the feet, or the arm-pits. A proper temperature also may be applied to the spine and back by means of the tin mattrasses filled with warm water, such as were recently used during the prevalence of cholera, in several of the hospitals. By these proceedings the influence of the air on the skin, in rousing the action of the capillaries, and imparting oxygen to the blood, is uninterfered with, whilst friction, the application of stimuli, and, above all, artificial respiration, can be advantageously resorted to.

We have been thus particular in detailing the researches of Dr. Edwards and their application to the human being when in a state of asphyxia, in consequence of the directions of the Humane Society being sanctioned by the authority of others who have treated of this subject. And no matter how great the caution exercised in avoiding the too sudden application of heat, the circumstances of the case must be very peculiar indeed which should warrant us in raising it beyond what we have already recommended, much less to the height of "98° or 100°".

Artificial Respiration.—Simultaneously with the employment of a well-regulated temperature, artificial respiration should be resorted to. When we consider that the natural process of respiration is carried on by the alternate dilatation and contraction of the thorax, and the admission of pure atmospheric air to the lungs, it is obvious that, in a state of asphyxia, the operation by which we attempt to restore respiration resolves itself into two processes. The first, by which we imitate the natural movements of the thorax, and the second, by which we convey air to the lungs, the latter process being called insufflation. Without the contemporaneous use of these two processes our measures generally prove abortive; and if insufflation alone be attempted the consequences may even be highly dangerous. There are many cases on record where animation was restored by the simple application of pressure to the chest and abdomen, by which a portion of the carbonised air was expelled, and on the pressure being removed, a portion of atmospheric air entered the lungs by the natural elasticity of the chest allowing it to recover its former dimensions; whilst, on the contrary, when insufflation was resorted to, without reference to the movements of the thorax, the most unhappy consequences have been the result. In accordance with the views of Goodwyn, who supposed the contractile power of the left heart to be destroyed, in consequence of the *venous blood* which was sent to it not being its proper stimulus, insufflation was injudiciously recommended, and for a time universally adopted; and as much as one hundred cubic inches of atmospheric air was advised to be introduced into the lungs at each inflation, with a force sufficient to overcome any impediment that might offer to its reaching the air-cells. The fatal results which must have followed an operation of this kind are obvious, and Leroy, whose instrument for insufflation we shall presently have to speak of, has satisfactorily shown, that without requisite caution, the most pernicious results follow. He ascertained that brisk sufflation of air into the trachea killed rabbits, foxes, goats, sheep, and other animals, even when the force employed was that of an expiration from the human lungs. To some other animals, however, such as the dog, the operation was not so injurious. Air, briskly introduced into the lungs, generally ruptures some portion of their tissue, and, issuing into the cavity of the pleura, occasions their collapse, and thus fatally interferes with the process of respiration. In order to prove this, air was injected through an opening in the intercostal spaces of an animal, and its immediate death ensued. On opening the bodies of animals killed by brisk insufflation, the diaphragm was found to be protruded into the abdomen, forming an elastic salient tumor in that cavity, and the lung was seen contracted into a small volume within the chest. Leroy and Majendie also revived some animals by making a puncture in the parietes of the chest immediately after brisk sufflation had been practised, and thus permitting the effused air to escape from the cavity of the pleura. Occasionally bubbles of air were introduced into the sanguiferous system by some rupture of the pulmonary vessels, and ecchymosis and effusion of air beneath the pleura were generally observed; and both Leroy and Majendie report that they frequently occasioned a rupture of the pulmonary tissue, and a consequent escape of air between the layers of the pleura, by forcible inflation in the human subject.

The directions given regarding this operation must therefore be received with some caution. This discovery reveals a sad retrospect of absolute evil, produced by the want of caution with which these means have been applied for the recovery of persons apparently dead, and show how presumptuous has been the interference of the most benevolent. The dangers are so great, that it is evidently not sufficient to diffuse a knowledge of them through the community, and to depend on the caution which this acquaintance with them may inspire; but it is desirable to have an apparatus which may be more safely entrusted to those who are distinguished by eminent professional sagacity and prudence [1].

Before attempting the resuscitative process, the following preparatory measures should be adopted. The body, stripped of its clothing, should be laid on a table, or on a board, supported by chairs of a convenient height: the head, shoulders, and chest, should be somewhat elevated, and, if necessary, the mouth and nostrils cleansed of mucus, which can be effected by means of a handkerchief wound round the finger.

As free a circulation of fresh air as possible should be permitted, and with this view the doors and windows of the apartment should be left open, and no more persons than are absolutely necessary allowed in the room. The body should be exposed to a proper warmth before a fire, at a temperature of from 65° to 70° Fahrenheit.

Bottles, containing warm water, or warm bricks, if the surrounding air be too cold, may be applied to the legs and arms. No heat however should be applied above 80° Fahrenheit, as a higher degree of temperature exhausts the vital energies. The natural and kindly warmth of a healthy person lying by the side of the body has been found, particularly in children, very efficacious. The warm bath should never be made use of, as water not only exerts an injurious influence on the body, but interferes with the exposure of it to the vivifying influence of the atmosphere.

These precautions being taken, pressure should now be made upon the chest and abdomen, by which the deteriorated air will be in part dislodged from the lungs; when, upon the pressure being withdrawn, fresh air will be received into these organs, in consequence of the capacity of the thorax being restored, in virtue of its own elasticity, as well as by the descent of the abdominal viscera. By applying the flame of a candle to the mouth and nostrils, or the down of a feather, it can be ascertained that on each firm pressure of the body air is expelled from the lungs, and that upon the pressure being removed, air rushes in.

In conjunction with these attempts to imitate the natural respiratory movements, and in the absence of a proper instrument for the purpose, insufflation may be performed in the following manner. Having closed the mouth of the body and one of the nostrils, the operator should blow into the other, having previously by strong suction removed as far as possible the deteriorated air. This method of insufflation when practised, should be performed through the nostril, the natural appendage to the respiratory tube, in preference to the mouth.

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[1] Kay on Asphyxia, p. 228.

We have hitherto supposed a case where no apparatus was at hand for the performance of these two operations; it is now necessary for us to describe the several instruments which have been recommended, and the use of which have been sanctioned by experience. The bandage of Leroy has been particularly described by the Humane Society, and is admirably calculated to produce the alternate contraction and dilatation of the thorax (figs. 111 and 112).

Fig. 111.

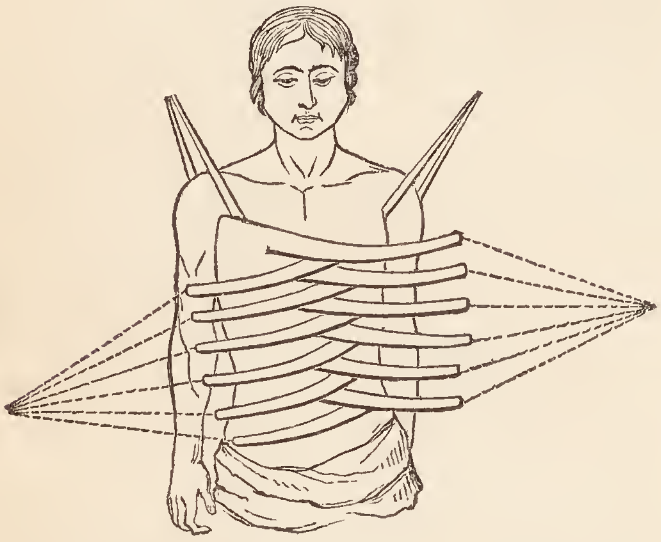
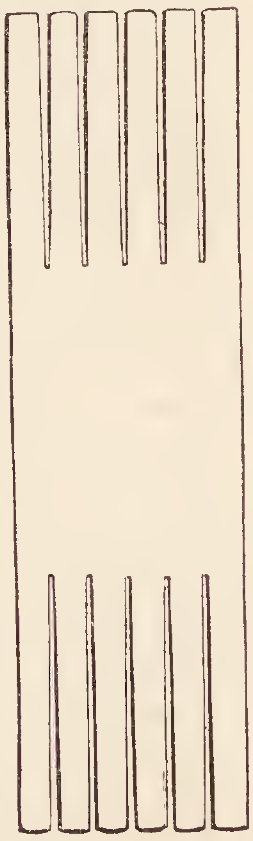


Fig. 112.



This bandage may be formed in the following manner. A piece of strong flannel, a blanket, sheet, or any other kind of cloth most easily to be obtained at the moment should be selected. It should be six feet in length, and eighteen inches in breadth; six strips should be cut or torn lengthwise on each side, and each strip should be three inches broad and two feet long. The untorn portion of this bandage should be placed under the back of the body, extending from the arm-pits to the upper part of the thigh bones, and the strips brought together over the chest and belly, interlacing each other from the opposite sides, as the fingers are interlaced in grasping the hands: the strips thus arranged should be gathered into a bundle on each side, and upon being drawn, by two assistants in opposite directions, the edges of the bandage will be made to approach each other, and firm and equal pressure will thus be produced on the thorax and abdomen.

When the assistants have made the necessary degree of pressure, upon their relaxing the bandage the thorax will expand; and if at the same moment the head and shoulders of the body be elevated, the diaphragm will follow the abdominal viscera in their descent. By these proceedings the capacity of the thorax will be increased in all directions, and the atmospheric air be invited into the passive lungs which follow its movements. The use of this bandage, and the inflation of the lungs in the manner directed, may be safely entrusted to the hands of non-professional persons, but the application of other instruments which have been devised for the performance of artificial respiration, or even the use of the ordinary pair of bellows for this purpose, should be entrusted to the surgeon solely.

For the purpose of introducing a curved canula into the glottis, with a view of injecting air into the trachea and its ramifications, Leroy has invented an instrument, which, by depressing the tongue and elevating the epiglottis, greatly facilitates this operation.

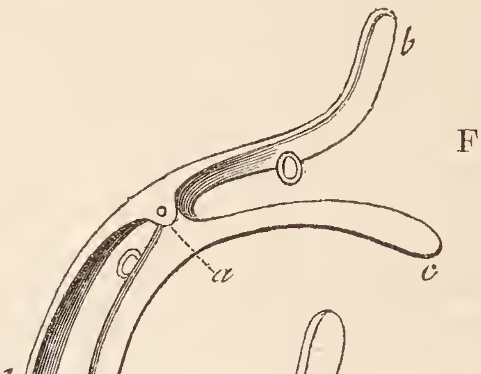


Fig. 113.

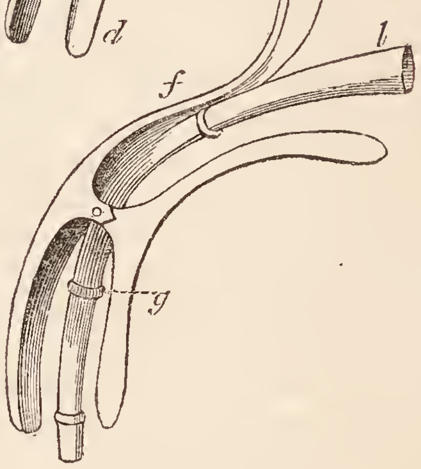


Fig. 114.

Figs. 113 and 114 represent Leroy's instrument; it is composed of two parts articulated at *a*, figure 113. The branch *b b* is fixed, the branch *c d* is moveable. When the extremity *c* is elevated towards *b*, the extremity *d* is depressed, and it is made to act on the base of the tongue so as to elevate the epiglottis. Fig. 114 represents the canula *l l* in its place in the instrument. It is attached to the fixed branch by a ring *f*, and at the other end it follows the motions of the other branch, to which it is attached by another ring *g*. The motion of this branch, at the same time that it depresses the base of the tongue and elevates the epiglottis, directs the canula to the opening of the larynx, and if it then be pushed forward it enters the glottis.

When the canula is thus introduced, the bellows provided with a graduated arc, indicating the quantity of air proper to be introduced at different ages, should be attached to the tube, and before commencing inflation, an effort should be made to remove by suction at the canula, any fluid that may be in the windpipe, such as water, mucus, or the deteriorated air. The larynx then being held backwards and compressed laterally between the fingers and thumb of an assistant, air should be cautiously impelled into the lungs. Having introduced a moderate quantity of air in this manner, the chest and abdomen should be compressed, so as to expel it, and this operation should be repeated regularly and steadily, until natural respiration begins, or until this and other measures have been persevered in for a long time. Dr. Currie recommends that these means should be continued "at least six hours without any appearance of returning life [1]."

The bellows which is represented at Fig. 115 is double valved, *a* the graduated arc, *b c* the valve which, moved in the directions of the dotted lines, permits the air expelled from the lungs during expiration to escape from the bellows. Leroy has also invented an apparatus for the purpose of warming the air before injecting it into the lungs. Fig. 116 represents a copper vessel in which the air is heated. There is a valve at *d*. The two stop-cocks, *b* and *c*, permit the air in the reservoir to escape when it is too hot. This air-vessel is to be heated by a spirit-lamp, (Fig. 117,) placed in the centre of a reflector, such as is represented in Fig. 118. The reflector is formed of two half circles, articulated together, so as to envelope the reservoir, as is shown in Fig. 119; openings are made in the upper part to permit the smoke to escape. In Fig. 118, which represents the concavity of the reflector, are eight metallic prominences *d*, *d*, *d*, *d*, intended to keep the reflector always at an equal distance from the reservoir.

Fig. 115.

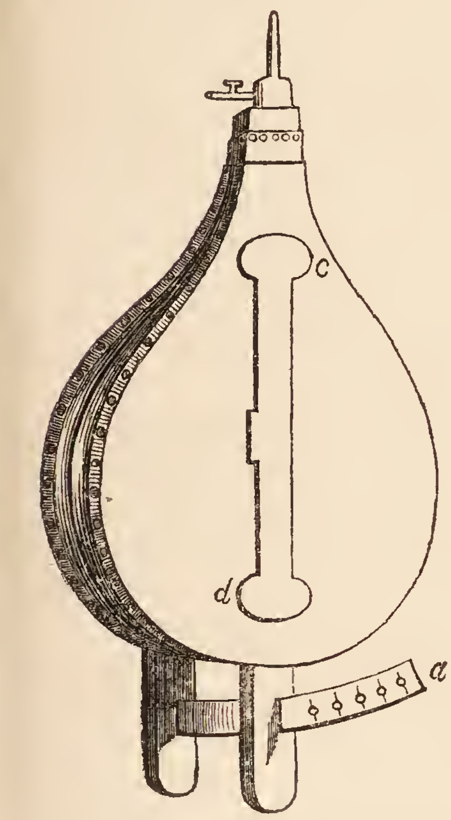


Fig. 116.

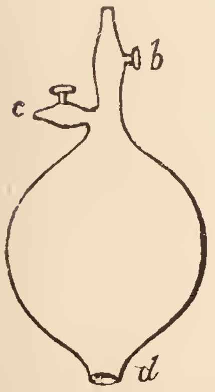


Fig. 117.

Fig. 118.

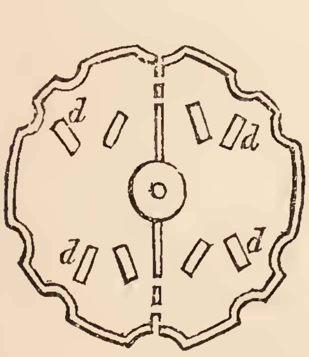
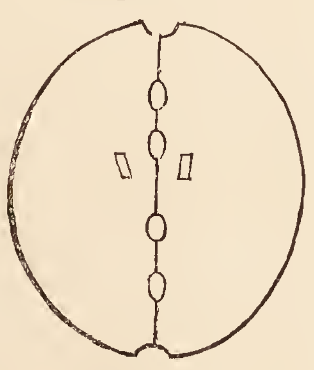


Fig. 119.



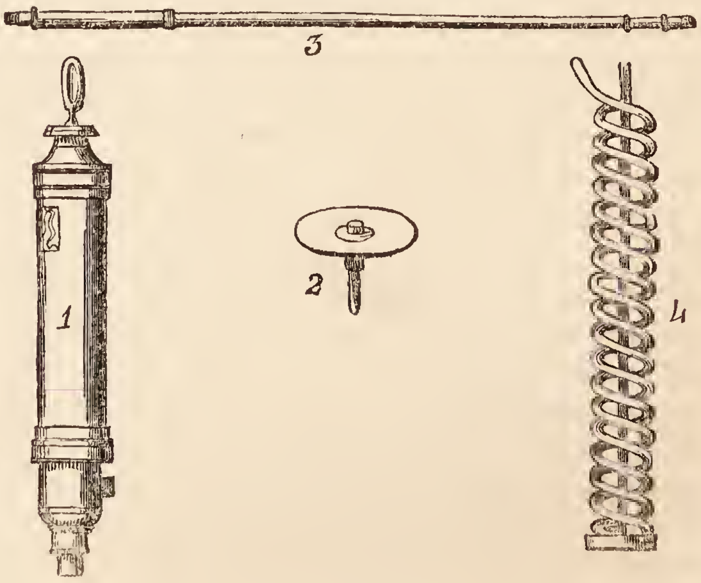
The experiments of Leroy and Majendie, which we have already referred to, are so decisive as to the necessity of using the utmost caution in introducing air into the lungs, that the following observations of Dr. Kay cannot have too wide a circulation.

"To men of great professional skill, and especially, when they are deeply imbued with a consciousness of the dangers encountered in this operation, the common double-valved bellows and common curved tubes may be entrusted, when other instruments are not at hand. Such men alone can ever be permitted to inflate the lung from the nostril with common kitchen bellows, as has been formerly recommended and practised; but which operation should never be performed, excepting in an extreme emergency, and then with a caution and skill which few can be expected to possess. To the danger of rupturing the air-cells by violence, or by an accumulation of air in the chest, is, under these circumstances, added the risk of inflating the stomach and bowels with air, and thus compressing the lungs. The dangers accompanying this method are therefore so great, that it is not described lest it should be rashly practised by improper persons."

The performance of tracheotomy, although recommended by surgeons of eminence, is now justly abandoned. All that is desired for the inflation of the lungs, can be accomplished by the introduction of a canula through the glottis, without encountering the delay which attends the operation of making an opening into the windpipe, or subjecting the patient, should our efforts be successful, to the after consequences of such a proceeding.

An apparatus has been invented by Mr. Read, which possesses the advantages of being both simple and safe in its application, and of enabling the operator to withdraw from the windpipe and its ramifications, a portion of the deteriorated air before introducing a fresh quantity. It consists of a syringe or pump (Fig. 120, 1.) which contains by exact measurement fourteen cubic inches; a mouth-piece or

Fig. 120.



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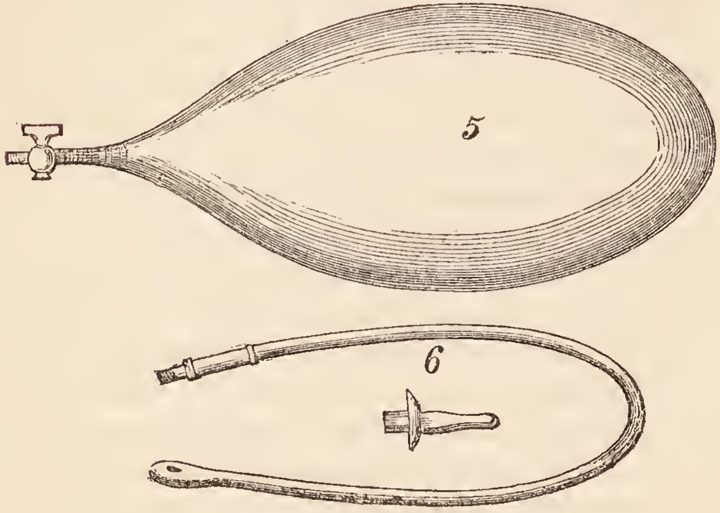
[1] Kay on Asphyxia, op. cit.

guard (Fig. 120, 2); a flexible tube for removing the deteriorated air (Fig. 120, 3); a coil of metal tube (Fig. 120, 4), by which it is proposed to heat the atmospheric air previously to its introduction into the lungs; an Indian rubber bag (Fig. 121, 5) which is air-proof, and is furnished with a stop-cock. With this apparatus a portion of the deteriorated air may be removed from the lungs in the following manner. The pipe of the mouth-guard is to be placed upon the tongue of the patient, and the guard pressed close to the lips by an assistant; one end of the tube (Fig. 120, 3) is to be inserted into the mouth-guard, and the other into the pump; the nostrils are then to be closed by an assistant to prevent the admission of air, and by cautiously working the pump not only deteriorated air, but also mucus or any other fluid can be removed from the windpipe. After each stroke of the pump if the fingers be removed from the nostrils, the pure atmospheric air will instantly rush in.

Fig. 121.



This instrument will be materially assisted in its operation by the application of Leroy's bandage, and indeed we would hesitate to make use of it, without employing at the same time alternate pressure and relaxation on the parietes of the chest.

Stimulants.—With a view of exciting the action of the heart and respiratory muscles, *friction* over the surface of the body should be employed, particularly over the chest and extremities, either with the hand, previously covered with flour to prevent abrasion, with a flesh-brush, or with a towel. The nostrils and fauces may be tickled with a feather dipped in spirits of hartshorn or aromatic vinegar; or the fumes of burning sulphur or other volatile irritants may be held under the nostrils. With similar views, warm and stimulating fluids may be introduced into the stomach by means of a flexible tube and syringe, such as brandy and water, spirits of hartshorn and water, negus, or water containing mustard, or essence of peppermint. Stimulating enemata of turpentine, of warm spirits and water, or of water containing salt or vinegar, may also be resorted to. The injection of tobacco smoke into the rectum has been recommended; but the uncertainty of this remedy, as well as the known depressing effects of tobacco, should deter us from its use. None of the remedies just enumerated should be employed, until some minutes after artificial respiration has been attempted. Mr. Hunter recommended the application of stimulating vapours to the interior of the lungs, but this practice has been justly condemned. Of little value also is the introduction of sponges fixed on whalebone, and impregnated with stimulating liquids into the stomach, for the purpose of more effectually exciting the mucous membrane of this organ; as the simple injection of stimulating fluids will answer all the purposes we have in view, without endangering the organization of the stomach itself.

"In the Berlin transactions we find a recommendation of the use of a ventriculi executia, or stomach-brush, to produce internal friction in the same manner. Dr. Good however prefers the stomach-mop. It is hardly necessary to caution the reader against the adoption of these extravagant proposals. Neither can we approve of the recommendation of the internal use of phosphorus, also recommended by Dr. Good on the authority of some German physicians, as one of the most powerful stimulants yet known[1]."

The use of either common or galvanic electricity in the different forms in which it is used in medicine, has been strongly advocated for the purpose of exciting the muscles of respiration, but this valuable agent is not always available, as it is seldom that an apparatus can be procured. To awake the respiratory muscles, electric shocks may be passed through the shoulders or chest. Dr. Ure has recommended that the phrenic nerve should be laid bare in the neck, and that one wire of the galvanic pile be connected with it, and another with the skin of the epigastrium, in order that the diaphragm may be stimulated to action by the galvanic current.

A new method has been proposed by Leroy: he introduced acupuncture needles, one on either side, between the eighth and ninth ribs until they penetrated a short distance into the fibres of the diaphragm; he then completed the galvanic circle by means of a pile of twenty-five or thirty pairs of plates, one inch in diameter, when the diaphragm immediately contracted and depressed the abdominal viscera, and an inspiration was made. The circle was then interrupted, when the diaphragm, urged by the weight of the abdominal viscera, and assisted by a gentle pressure made on the abdomen by the hand, returned to its former position, and an expiration was accomplished. By alternately repeating these operations respiration was re-induced; but when a continuous current was applied, the respiratory movements were irregular. In the experiments of Leroy, which were witnessed by Majendie, animals were often resuscitated after five minutes' submersion by the application of galvanism in the manner just described. Although in the majority of cases of asphyxia which present themselves in private practice, the employment of electricity cannot be resorted to for want of a proper apparatus, yet in the several stations for the reception of persons asphyxiated, such an apparatus should be always in readiness.

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[1] Roget, in Cyclopædia of Practical Medicine.

Bleeding.—The propriety of including this powerful remedy, which always requires in its employment the nicest discrimination and the greatest caution, under the head of "general treatment of asphyxia" is questionable. We shall therefore here merely state that bleeding has been strongly reprobated by some, and as strongly extolled by others, and shall reserve any further observations on its employment, until the particular varieties of asphyxia come under our notice.

The measures just described for the recovery of persons in a state of asphyxia, should be persevered in for several hours. When they are successful, the first signs of returning life are evinced by slight convulsive snatchings of the respiratory muscles at longer or shorter intervals, which are succeeded by gaspings and sighing. These convulsive respiratory efforts become more and more regular; the heart flutters, and palpitations succeed; natural respiration is at length restored, the heart's movements become regular, the circulation is established, and the anxious finger at the wrist receives the announcement of restored animation by the *pulse*. All danger to our patient however is not now over; on the contrary, many serious consequences may ensue. Dr. Paris gives the case of a corporal of the guards, who was seized with cramp as he was bathing, and remained for several minutes under water. By judicious assistance he recovered, and appeared to those about him to be out of danger, when he was attacked with convulsions and expired. Another case is on record in which the most furious delirium came on immediately after resuscitation from drowning[1]. In all cases of restored animation, the effects of reaction should be cautiously watched, and combated, as the symptoms present themselves.

VARIETIES OF ASPHYXIA.

On referring to the *causes of asphyxia* it will be seen that we have reduced them to two general heads, either as the respiratory apparatus itself is directly or indirectly affected, or the respiratory medium, the air, is so deteriorated as to render it unfit to carry out the essential chemical object of respiration. It now remains for us to consider briefly the varieties of asphyxia which are embraced under each division, and it will not only be more systematic, but also better suited for all *practical* purposes, to treat of each in the order already given. We shall therefore take for our text, the causes of asphyxia, and consider each variety in succession; at the same time dwelling more particularly on those varieties which most frequently present themselves to the practitioner, or which demand either a modification of the general principles of treatment we have just noticed, or the employment of other remedial agents.

The first variety of asphyxia, or that which arises solely from external pressure upon the thoracic parietes, but seldom presents itself. In addition to the cases where the expansion of the thorax is prevented by the individual being buried up to the neck in the earth, or by his being enveloped in plaster of Paris for scientific purposes, we may notice others which must be fresh in the recollection of our readers, but which are now unknown.

In Edinburgh, and in this metropolis, monsters in human shape destroyed the lives of their fellow-beings, by kneeling upon their chest and abdomen, so as to prevent the action of the respiratory muscles, at the same time excluding the air from the lungs by closing the nostrils and mouth with their hands. In this way the miscreants soon extinguished the life of their victims, leaving few, if any, traces of violence.

The negligence of the legislature to the anatomical wants of the practitioner and student in medicine, led to these atrocities.—Thanks to the indignation and horror which their discovery excited, the proper preventive has been since adopted, and the lives of citizens are protected from this source of danger. It consequently becomes unnecessary to dwell on this variety of asphyxia. The same course may be adopted as regards the second and third varieties, and we shall therefore pass to the fourth, in which asphyxia is induced by causes which prevent the access of air to the lungs, by producing obliteration of the respiratory tube. Of these causes of asphyxia, the most important to the practitioner, and at the same time the most interesting, are submersion, strangulation, and the presence of non-respirable gases. We propose to consider these in the order we have placed them.

Submersion.—Asphyxia produced by submersion, or drowning, is of any variety the most interesting, whether the frequency of its occurrence, the combined destructive influences of the absence of atmospheric air, and the presence of water, or the phenomena which death by drowning exhibits, be considered. In medico-legal investigations also, it is a question of paramount importance, whether the individual whose body was found in the water came by his death from drowning, was placed there after life was extinguished with a view to avoid detection, or was intoxicated or stunned at the time of his submersion.

When an individual is submersed, he makes an effort to inspire, and water is taken into the mouth; but as soon as this fluid reaches the glottis, its muscles are excited, and they contract spasmodically. This state continues so as to prevent almost totally the entrance of a fluid not fitted for animals who respire through the medium of the atmosphere, and produces asphyxia as effectually as if the trachea itself was obliterated by the application of a ligature. This is what takes place on continued submersion, and death speedily supervenes; but if the individual rises to the surface and struggles for existence, his death is more or less prolonged, and a small portion of the water may enter the trachea during the imperfect attempts which he makes to inspire.

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[1] Archives Gén. de Méd.

We once had occasion to witness, with intense anxiety for the safety of a friend who could not swim, and who got beyond his depth when bathing, the following phenomena: he first made violent and irregular struggles with his arms extended, to support his head above the water, but these being ineffectual, he sank to the bed of the river; on reaching which, *conscious* of his danger, he struck his feet against it with such force as to raise his head and chest considerably above the surface. He now called for help loudly, and cast his arms about him at random, as if endeavouring to grasp something which would support him, but almost immediately sank; He soon rose a second time much exhausted; when, upon the point of his again sinking, he was rescued from his peril, brought to shore, and soon recovered. He stated his recollection of having called for help, but after that he lost all consciousness.

It was at one time a prevalent opinion, that the cause of death from submersion arose in consequence of the water entering the trachea and filling its ramifications. Even at the present day this opinion is found occasionally to hold its popularity amongst the uneducated, and which leads to the pernicious practice of suspending by the heels, the body of the individual who has undergone submersion, for the purpose of giving exit to the water which has been supposed to have entered the windpipe. The experiments of Morgagni, Haller, Louis, Goodwyn, &c. upon animals, and their examination of the bodies of persons who have been drowned, prove that water seldom enters the trachea, and that when it does so, it is in exceedingly small quantities, and during the last struggles of the individual.

Louis drowned animals in coloured fluids, and ascertained that a small quantity entered the trachea. Goodwyn also repeated these experiments with a similar result. He also drowned animals in quicksilver, and ascertained that when a cat was immersed in this fluid, five drachms, an exceedingly small quantity when its weight is considered, entered the lungs. In order to determine whether the presence of a small quantity of water in the lungs would occasion death, Goodwyn performed the following experiment; he made an opening in the trachea of a cat, and through it introduced two ounces of water into the lungs; its presence was followed by a difficulty of breathing and weak pulse, which effects soon subsided, and the animal lived several hours afterwards without further inconvenience. It was now strangled, and two ounces and a half of water were found in the lungs. It was thus proved that water entered the lungs, but not in a quantity sufficient to produce death.

The existence of the frothy mucus which is sometimes found in the bronchia and its ramifications can be only accounted for by the animal having risen to the surface and respired air once or twice during its last struggles.

It is difficult to lay down any rule by which it can be determined *à priori*, whether our attempts at restoration will be successful, beyond the signs which characterize the existence of total death. Whilst, on the one hand, a few minutes' submersion have been sufficient to baffle the most energetic and well-directed measures of the practitioner in his attempts at re-animation, cases on the other hand are on record, where recovery has crowned his efforts after the body has been fifteen, twenty, and even thirty minutes in the water. The longest period recorded by the Humane Society, of recovery after submersion, is three quarters of an hour.

GENERAL DIRECTIONS FOR THE TREATMENT OF THE DROWNED.

When the body is taken out of the water, the mouth and nostrils should immediately be cleansed; sometimes much frothy mucus will be found in the throat; this should be carefully removed with a handkerchief tied round the finger: the wet clothes should be immediately stripped from the body, which should be wiped dry and clean, and then, without exposing it to a cold atmosphere one moment longer than necessary, it should be wrapped in a dry blanket. In conveying the body to the nearest house, the assistant should forbid its being lifted or carried by the shoulders and legs, because in this position the head is unsupported, and its weight will hang forwards on the chest, or fall backwards. The body should be carried on a blanket, or on a board (a door), or in a cart. A room, containing a good fire, should, if possible, be selected[1].

The resuscitative measures, which we have already spoken of under the *General Treatment of Asphyxia*, should now be put into operation and persevered in with a caution and energy, and for a length of time commensurate with the importance of the humane object the practitioner has in view.

Strangulation.—Asphyxia may be induced in this way by simple pressure round the neck, sufficiently powerful to prevent the passage of air through the trachea, as by the application of a cord, a handkerchief, or by the hands; or this pressure may be complicated with suspension of the body, as in hanging; also with rupture of the ligaments of the cervical vertebræ, fracture of these vertebræ, injury to the spinal chord, or to the nerves in the vicinity of the ligature.

Death from strangulation has attracted the attention of the profession from the earliest periods. It was supposed that the compression of the internal jugular veins produced insensibility; and in the belief that when the carotid arteries were tied the person must fall asleep, these vessels obtained the name, at one time, of *arteriæ soporales*. In John Bell's anatomy, 1797, we read that the wildest and most barefaced tale that ever was told, is that delivered by a pupil of Realdus Columbus, named Valverdus, in his Anatomy of the Human Body. The carotid arteries (says Valverdus) being tied up, or any how obstructed, the person grows stupid, and falls presently into a profound sleep, This experiment I saw at Pisa in the year 1554. It was performed upon a young man by the celebrated Columbus in the presence of a great many gentlemen and strangers, with no less misery to them than amusement to us (the pupils), who, though we knew the cause, ascribed it altogether to the black art. Galen attributed death from hanging to the lesion of the pneumogastric nerves, and after his time it was generally supposed that death was occasioned by the pressure on the jugular veins preventing the return of blood transmitted by the carotid and vertebral arteries, and thereby producing apoplexy. An experiment was performed by the elder Monro, which proved most satisfactorily that death by hanging was produced by asphyxia. He made an opening in the trachea of a dog, and suspended the animal with a cord in such a manner that the opening was beneath it, and the air had free access to the lungs, as in respiration. He was suspended in this way for three quarters of an hour, during which time the circulation and respiration went on as usual, and he was then taken down. The cord was then removed, and applied below the opening in the trachea, so as to prevent the entrance of air to the lungs; the animal was again suspended, and in a few minutes it died. The chief cause of death from suspension arises in consequence of the interruption of respiration; the circumstances which may accompany the application of the cord may materially affect the duration of life in the individual suspended. The rope may be so placed above the larynx as not to occasion a perfect obliteration of the windpipe; and in such cases the small supply of air may prolong the tortures of the being for some time, although incapable of maintaining life. Inexpertness of this kind, on the part of the executioner, together with the absence of the gallows of modern times, must doubtless have been the cause of the many recoveries from hanging, which are on record. We have had occasion to know, from authentic sources, the successful recovery of two individuals who had undergone the sentence of the law, and whose bodies, after being suspended the usual time, were delivered over to their friends. In both cases the external jugular vein was opened, and frictions over the surface of the body and extremities were persevered in. A subscription was afterwards raised for one of them, and he was privately sent out of the country.

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[1] Kay on Asphyxia, p. 50, 51.

Life may also be preserved in consequence of the larynx and trachea being ossified, a condition by no means unfrequent. A case of this kind is related in Dr. Plott's Natural History of Staffordshire. In the reign of Henry VI. a woman, named Snetta de Balsham, after having undergone the sentence of the law, and being suspended an entire night, was cut down, and found to be still alive; having owed her preservation to her larynx being ossified. This case was considered at the time to be so wonderful that she received her pardon. The injuries which may attend hanging, besides the exclusion of air from the lungs, must depend upon a variety of circumstances; such as the weight of the body, the length of the drop, the manner of fixing the rope, and so on.

Besides the interruption to the respiration which takes place from hanging, there are in general some remarkable symptoms presented which show great disturbance in the sanguiferous and nervous systems. The being struggles more or less (convulsions of the voluntary muscles), the vessels of the face and head are congested with livid blood, the eyes are protruded, and the conjunctivæ are suffused, more or less mucus is in the mouth and nostrils, and the tongue is congested, and sometimes thrust out of the mouth. We have not observed any great distortion of the features. The sphincters relax, and the urine, and sometimes the fæces, are passed involuntarily; semi-erection of the penis occasionally takes place, and less frequently emission of semen.

Mr. Houston, in the Dublin Hospital Reports, has given an interesting account of the effects of the rope on the necks of criminals who suffer death by hanging, at the examination of two of which we were present. "Both individuals were strong plethoric men, executed for murder of tradesmen of their own craft, under the combination system. Their death was evidently caused by strangulation. The cervical vertebræ were unbroken, and the spinal marrow and brain presented no marks of injury. In both the sterno-mastoid muscles on the right side (the opposite to that on which the knot of the rope was applied), were ecchymosed, contused, and broken; those of the left side were only slightly bruised. The os-hyoides and thyroid cartilage were completely severed from each other. The omo-hyoid, sterno-hyoid, and thyro-hyoid muscles were so bruised and lacerated that only some stretched shreds of them remained to hold the parts together. The thyro-hyoid membrane was also torn across, and the epiglottis, pulled from its roof at the back of the thyroid cartilage, had passed up with the os-hyoides and the tongue into the back part of the mouth; the skin alone remained unbroken, and interposed between the rope and the cavity of the pharynx. This was the only region of the neck which gave evidence of much injury, the great vessels and nerves all escaped unhurt. On two other criminals, which more lately I have had an opportunity of examining, precisely the same effects had been produced by the rope on the soft parts of the neck, and without any injury to the brain or spinal marrow. Two preparations, illustrative of the above statement, may be seen in the museum of the College of Surgeons. The resemblance in the effects of the injury is remarkably striking."

In addition to the appearances observed by Mr. Houston, I found, after macerating the bones of one of these criminals, that the dentata was fractured at the junction of its laminæ with its body, but, from the little displacement of the fractured pieces, no pressure could have been exerted upon the spinal chord. The preparation of this vertebra, together with several other bones of the individual, are now in my museum.

We learn from manuscript notes furnished to Dr. Paris, that Sir Benjamin Brodie thinks an animal may recover from the direct consequence of strangulation, and may suffer from the effects of the ligature on the nerves afterwards. Sir Benjamin Brodie passed a ligature under the trachea of a guinea pig, and tied it tight on the back with a knot; the animal was uneasy, but nevertheless breathed and moved about; at the end of fifteen minutes the ligature was removed; in the following morning, however, the animal was found dead. On dissection, no preternatural appearances were discovered in the brain, but the lungs were dark and tinged with blood, and presented an appearance similar to that which is observed after the division of the pneumogastric nerves. "I do not," (observes Sir Benjamin Brodie) "positively conclude from this experiment that the animal died from an injury inflicted on the eighth pair, but I think that such a conclusion is highly probable, and it becomes an object of inquiry whether a patient, having recovered from hanging, may not, in some instances, die afterwards from the injury of the par vagum."

But it was not until 1831, that the effects of ligatures on the blood-vessels and nerves of the neck were fully investigated, when Sir Astley Cooper instituted a series of admirable experiments in elucidation of this subject; a full account of which will be found in the Guy's Hospital Reports for 1836. The preparations, illustrative of this subject, were kindly shown me by Sir Astley Cooper himself. The inferences which he draws from his experiments are thus stated:—"It appears, from these experiments, that the carotid arteries are designed in these animals (dogs and rabbits), rather for the supply of blood to the external parts of the head than to the brain itself; whilst, in proportion as the brain is more developed, the carotid artery acquires greater importance. The obstruction of it influences respiration in some degree; probably, because, under these circumstances, more blood is directed to the vertebral arteries. The internal carotid branches are proportionably less than in those animals which have a large cerebrum, and are endued with higher mental faculties. It passes to its destination, to prevent the action of the heart from influencing the brain immediately.

"The rabbit quickly recovers from the operation of tying these arteries, and seems little affected by it; and in man, as well as in these animals, these vessels are obliterated without the destruction of life.

"The vertebral arteries are much more important vessels, as regards the brain and its functions in these animals[1], than the carotid arteries. The nervous power is much lessened by tying them; and, in these experiments, the animal did not, in any case, survive the operation more than a fortnight; although I do not mean to say that recovery is impossible. In the dog, also, the carotids may be tied with little effect; but the vertebrals have a great influence. The effect of the operation is immediately to render breathing difficult and laborious, from the supply of blood to the phrenic nerves, and the whole course of the tractus respiratorius of Sir Charles Bell being stopped. The animal becomes dull, and indisposed to use exertion or to take food. Very slight injuries, after a ligature has been put upon these arteries, will destroy life; insomuch, that if they are fresh tied, even dissecting for the carotids, without tying them, will cause death. The best method, in such experiments, is to tie the vertebrals last.

"On account of the importance of these vessels, they are securely defended by bone in the greater part of their course; and it is only below the sixth cervical vertebra that they are accessible. If they were exposed to pressure, death would often be suddenly produced. These arteries are tortuous, to prevent too sudden a rush of blood to the head; and they pass through foramina of bones, which prevents any great increase of their size; although they become somewhat larger than before, when the carotid arteries are tied, and *vice versa*. Thirdly, compression of the carotid and of the vertebral arteries at the same moment in the rabbit, destroys the nervous functions immediately. This is effected by the application of the thumbs to both sides of the neck, the trachea remaining quite free from pressure; when respiration entirely ceases, with the exception of a few convulsive gasps.

"The same fact is evinced in a clearer and more satisfactory manner, by the application of ligatures on the four vessels, all being tightened at the same instant; when stoppage of respiration and death immediately occur. When the dog is the subject of this experiment, it loses its volition and sensation, and appears as if it were intoxicated; but the anastomosing vessels gradually restore the circulation by means of the other branches of the subclavian artery at the back and sides of the neck.

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[1] Mr. Coleman informs me that the vessels of the horse are different; and he thinks it is designed to counteract gravitation, when the animal is feeding on grass.

"But, notwithstanding the decisive nature of the last experiment, conceiving that it might be possible that the pressure upon the nerves of the neck might have an influence in killing the animal suddenly, I made the experiments which I have detailed. I first tied the pneumo-gastric nerves, and found that the animal lived about twelve hours, although it died on the instant when the carotid and vertebral arteries were tied: the lungs were also loaded with blood[1], and twice as heavy as the healthy lung: it appears, therefore, that the change of the blood is either directly or indirectly under the influence of the par vagum. In this experiment it is also to be observed, as a point of much importance, that the blood in the carotid arteries is found of a venous character, and dark blood circulates in the animal for some time before it dies, the blood being less arterial as the time elapses from the application of the ligature: yet the heart continues to beat; for when the artery is opened, the blood flows *per saltum.* The blood also flows of a dark colour when the carotid is opened after the phrenic has been tied; but the lungs are not in that case found loaded with blood; but possessing their ordinary weight and appearance. In this experiment there was also a remarkable diminution of animal heat. Is this to be attributed to a cessation of that pulmonary process, accompanied by the evolution of heat wherein venous is converted into arterial blood? or does it arise from a want of that supply of arterial blood to the nerves, from which they derive a capability of evolving caloric? or shall we not approach still nearer to the truth, in supposing that both these causes of a high temperature are suspended at the same time; and that there is, consequently, a double reason for the gradual departure of the animal heat observed in this experiment.

"The œsophagus contained food, in some instances in which the animal had eaten after the experiment, from its muscles being paralyzed; and the stomach was full, from the arrest of the digestive function.

"This nerve, then, is most important; 1st, in assisting in the support of the function of the lungs, by contributing to the changing of the venous into arterial blood; 2dly, in being necessary to the act of swallowing; 3rdly, in being very essential to the digestive process[2].

"The pair of nerves upon which I next applied ligatures were the phrenics. As soon as these were tied, the most determined asthma was produced; breathing proceeded by means of the intercostal muscles; and the chest was elevated to the utmost by them; and in expiration the chest was as remarkably drawn in. The animals did not live an hour; but they did not die suddenly, as they do from pressure on the carotid and vertebral arteries. The lungs appeared healthy: but the chest contained more than its natural exhalation.

"When the grand-sympathetic was tied, little effect was produced; the animal's heart appeared to beat more quickly and feebly than usual; but of this circumstance I cannot be positively certain, on account of the natural quickness of its action. The animal was kept seven days, and one nerve was ulcerated through, and the other nearly so, at the situation of the ligatures. The suppurative process was extensively set up around the ligatures. No particular alteration of any organ was observed on examination. Another animal still lives, in which the sympathetic was tied nearly a month ago.

"Lastly, I tied all three nerves on each side, the pneumo-gastric, phrenic, and grand-sympathetic; and the animal lived little more than a quarter of an hour, and died of dyspnœa. The sudden death, then, that takes place from pressure at the sides of the neck, must not be attributed to an injury to the nerves, but it is owing to the impediment to the due supply of blood to the grand centre of nervous influence[1]."

Treatment.—"In addition to the employment of the agents recommended under the head of general treatment of asphyxia, the following precautions should be observed in the treatment of asphyxia from suspension. The ligature should be removed from the neck immediately, and the head and shoulders should be raised considerable higher than the trunk. The body should be stripped of its clothing, and its surface exposed as freely as possible to the air. As the victim has not been plunged into a cold medium, it is not necessary to apply a temperature higher than 68° Fahrenheit. Frictions should be performed, and artificial respiration resorted to as soon as possible, and with a due observance of caution. Bleeding is called for in the treatment of this variety of asphyxia; the external jugular vein should be opened, and a quantity of blood abstracted with the view of relieving the vessels of the scalp, and of the integuments of the face and neck, of their turgescence, as well as of equalizing the disturbed circulation within the cranium. Great caution, however, should be observed in its employment, not to take more blood than is absolutely necessary for these purposes, lest the powers of life should be weakened. After recovery blood may be, and often is required to be taken in a much larger quantity, than previously to the renewal of respiration."—*Royal Humane Society's Report.*

Amongst the gases which produce death, when present, some act as poisons, others act a negative part by their presence excluding oxygen, and others produce asphyxia by causing spasm of the glottis.

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[1] Sir Benjamin Brodie has mentioned this state of the lungs.

[2] A ligature on one nerve only does not destroy.

[1] In a conversation which I lately had with Sir A. Cooper, I find he considers that the nervous power, and indeed all the powers of the body are supported by the presence of arterial blood; and that the nervous system is to be regarded as secondary to the arterial.

The poisoning gases do not give rise to any of the symptoms of asphyxia; they produce positively deleterious effects on the system, simply as poisons. The gases which exert a negative influence on the system, are seldom collected in sufficient quantity to extinguish life, and their effects differ little from those of simple suffocation. Should a person be asphyxiated by the inhalation of any of these gases (*vide causes of Asphyxia*) insufflation should be performed as speedily as possible, cold water should be dashed on the head and chest, to excite the respiratory system of nerves, and to reduce the temperature to a degree of warmth more consistent with the maintenance of vital action when animation is suspended. The body should be freely exposed to the atmosphere at about 70° Fahrenheit, and friction and the other remedies appropriate to the recovery of the drowned, should be employed with the utmost assiduity. —(*Royal Humane Society's Report.*)

Asphyxia from the respiration of carbonic acid gas.—Carbonic acid gas is frequently the cause of fatal accidents. Whenever combustion is going on it accumulates, and many instances of death are on record produced by the combustion of charcoal, the ventilation of the apartment having previously been impeded. It is often present in caverns, mines, wells, and lime kilns, and in the vats in which vinous fermentation has been carried on. In brewing establishments it has often proved fatal to those who have descended into the vats incautiously. In volcanic regions, carbonic acid gas is known to issue from fissures in the rocks in large quantities, and to collect in caverns. The Grotto del Cane, at Naples, receives its name on account of dogs being kept near the spot for the purpose of exhibiting to travellers the effects of this gas; the dogs are immersed in the gas collected in the lower stratum of air contained in the grotto, until asphyxia is induced. In mines it is constantly found diffused through a large mass of air, and is known by the name of *choke-damp;* where in consequence of its greater specific gravity, it sinks to the lowest part of the mine, and hence is with much difficulty dislodged. A case is recorded by Dr. Paris[1], which occurred at Leighton-Buzzard, in Bedfordshire, where asphyxia was caused by the discharge of *mephitic gas* from plants.

"Mr. Sherbrook having frequently had his pinery robbed, the gardener determined to sit up and watch. He accordingly posted himself with a loaded fowling-piece, in the greenhouse, where it is supposed he fell asleep, and in the morning was found dead upon the ground, with all the appearance of suffocation, evidently occasioned by the discharge of *mephitic gas* from the plants during the night."

When pure carbonic acid gas is attempted to be inspired, it immediately produces spasmodic action of the glottis. Sir Humphrey Davy introduced into a silk bag some carbonic acid gas and attempted to inspire it; but it was in vain that he made the most powerful and repeated efforts to draw it into the trachea. It communicated a strong acid taste to the mouth and fauces, and occasioned so much painful irritation as to occasion a complete closure of the glottis. When, however, the gas was diluted with about double its volume of common air, Sir Humphrey Davy was enabled to breathe it for nearly a minute, when it produced a slight degree of giddiness and an inclination to sleep.

"When the diluted gas is inhaled, it has a pernicious influence on the nervous system, and the fatal effects ensue after a shorter interval than when hydrogen or nitrogen only are inspired. Its influence is, apparently, of the most sedative character, and death ensues, attended with little or no suffering. The younger Berthollet committed suicide by shutting himself up in a close apartment, in which carbonic acid gas had accumulated from a coffer of charcoal. He sat calmly at the commencement of his fatal experiment, to record the sensations with which he was visited, and they appear to have been just such as would have been produced by a narcotic poison. Then an illegible word occurred; and it is supposed that at this moment the fatal effects suddenly supervened, that his hand fell powerless, and he ceased to exist[1]."

Mr. Snow informs me that he has inspired some pure carbonic acid gas, and that it only produced a tickling of the fauces. A most interesting case is related by Dr. Babington, in the Medico-Chirurgical Transactions, of the effects produced by the slow combustion of charcoal. The waiter of a tavern, and a little boy thirteen years of age, went to bed, and not having risen between six and seven o'clock the following morning, a person went to the chamber, and found the waiter insensible, and apparently at the point of death; the poor lad lying lifeless on the floor, and a chafing dish, containing some extinguished charcoal, at the foot of the bedstead. An attempt was made to restore the boy, by insufflation of the lungs and the use of galvanism; but no signs of life having, after some time, been manifested, he was reluctantly abandoned to the insensibility which oppressed him. The waiter was removed into a larger and more airy apartment; his breathing was stertorous, the countenance flushed, the lips livid, the pulse full and strong, and about ninety in a minute, and ten ounces of blood were therefore abstracted from his arm by his attendant.

After some time (when Dr. Babington first saw him), the pulse had become weak and quick, and the respiration very imperfect; though the heat of the upper part of the body remained. The power of voluntary motion was suspended, and slight convulsive twitchings of the muscles, which at first prevailed, altogether ceased. Sensibility was extinct, the countenance pale, the eyelids closed, the eyes prominent and rolling, the tongue swollen and projected from the mouth, and the jaw locked upon it, whilst a copious discharge of saliva issued from the corners of the mouth. The window of the room, in which there was no fire, was left open, and the external temperature was about 50° Fahrenheit. On passing a galvanic shock through the chest, the patient drew his breath deeply. The muscles of the abdomen were seen to reach, though feebly, while those of the face were slightly convulsed, and the eyelids raised. The respiratory motions became more powerful at each successive application of the galvanic current, and the arterial pulse was gradually developed.

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[1] Paris and Fonblanque. Medical Jurisprudence.

[1] Kay on Asphyxia.

After a certain interval, a bladder of oxygen gas was respired by the patient. As the heat of the body was not diminished, water was dashed on the head and face, and the respiratory muscles were evidently stimulated by this application. The inhalation of oxygen was repeated, and the galvanic shocks were applied alternately to the head and chest every half-hour for some time, until it seemed that the excitement produced by them, was followed by a corresponding depression, and they were therefore discontinued. Ammonia was rubbed on the temples and chest, and its vapour inhaled; which latter application rendered him uneasy, and excited coughing. These and other means were continued, until a warm perspiration broke forth, and his condition rapidly improved, In the afternoon, the pulse had risen to 120, and was strong, but, as the stupor had diminished, a bleeding which had been proposed was postponed. In the night, however, the bandage came away from the arm, and he lost nearly a pound of blood, and it appeared probable, for some time, that he would not be able to survive the effects of this hæmorrhage; but during the night he recovered, and on the following day was able to speak, though very imperfectly. For two days, the left side of the face appeared paralysed, and his mind considerably disordered. He recollected nothing from the time that he lay down, when he remembered having seen the charcoal burning brightly, till the second or third day after the accident.

The appearances after death from this cause are very various. (Vide Dr. Bird's paper in *Medical Gazette*, March 10.)

Treatment.—The patient should be immediately withdrawn from the deleterious atmosphere, and his clothes removed, in order that the pure air may come in contact freely with his skin. Cold affusion over the head and chest may be employed, the water being dashed upon the face and chest. If, however, there be great loss of heat, this remedy may be abstained from. Frictions over the chest should be persevered in, and ammonia be held to the nostrils. Insufflation and the other means recommended under the head of general treatment, are also demanded. Bleeding may sometimes be necessary, but it should be resorted to with much caution, as the instructive case of Dr. Babington shows us, not only in our primary attempts to restore animation, but in our after treatment.

We have had no opportunity of testing the application of Mr. Read's instrument, for the removal of deleterious gases from the lungs, in an asphyxiated being; but from the experiments which we witnessed Mr. Read perform upon himself, we are satisfied of its capability of exhausting these organs. Its application then in those cases of suspended animation, where a gas of the specific gravity of carbonic acid, is in large quantities in the lungs, cannot but be desirable for the purpose of removing a portion of this deleterious agent bofore sending into these organs pure atmospheric air, or even oxygen itself.

The other varieties of asphyxia, which arise from the adventitious membrane of croup, chronic laryngitis, abscess of the glottis, abscess of the tonsils suddenly bursting and pouring its contents into the larynx, foreign bodies in the larynx and œsophagus, and so on, will fall under consideration in the special articles devoted to these cases.

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(*Philip Bennett Lucas.*)

ASTRINGENTS, (derived from *astringo*, to bind,) a class of therapeutic agents which are distinguished by the property they possess of exciting primarily the vital contractility of the animal fibre, which, however, their prolonged use has ultimately a tendency to injure, by blunting the sensibility and augmenting the density of the organic tissue.

Their action is both general and local; the local appertains more exclusively to the province of surgery.

Astringent local applications comprise vegetable substances whose peculiar characters depend on the tannin they contain, and certain mineral products; cold through the medium of cold air, water, and ice, is also regarded as an astringent.

By their modus operandi they tend, in the first place, to counteract laxity of the general tissues of a region; secondly, by diminishing the capacity of the blood-vessels, especially of the capillaries, and retarding the flow of blood through an inflamed part, they reduce inflammation in certain stages of its course; to the same effect their styptic virtues are to be ascribed (see STYPTICS); and, thirdly, they restrain discharges, whether natural or morbid, secretory or excretory, by narrowing the orifices of those ducts or vessels through which they exude.

The astringent operation of cold applied to a surface of much extent is not very lasting; the local effect is soon followed by general reaction, which speedily overcomes the temporary resistance opposed to it, and perseverance in the remedy, under such circumstances, becomes injurious.

The tonic action of the more powerful astringents, as we have before remarked, is likewise transient; it results from a simple corrugation of fibres, and not from any real increase of the vital powers.

The remedial operation of astringents ought, therefore, to be limited in duration, as it nearly always becomes pernicious when long continued.

The vegetable astringents most employed in surgery are oak-bark, galls, kino, catechu, and acetic acid; they are often prescribed in combination with salines.

Those derived from the mineral kingdom consist of the acetate of lead, the sulphates of silver, copper, iron, zinc, tin, and the nitric and the dilute sulphuric acid.

(*Henry T. Chapman.*)

ATHEROMA, (from ἄθηρα, pap,) a species of tumours containing a pap-like or semifluid matter. (See TUMOURS, ENCYSTED.)

ATRESIA, (from α privative, and τρῆσις, the act of boring, perforation,) congenital closure of any canal, or part of the body, which, in the natural state, opens externally. (Vide IMPERFORATION.)

ATROPHY, (from α, priv. and τροφή, nutrition; *atrophia*, Lat.; *atrophie*, Fr.) This word expresses the gradual wasting of the body, either wholly or partially. Atrophy is often symptomatic of disease, either acute or chronic; it may also take place when no morbid action is present, in consequence of inaction alone, or of pressure being made upon an organ. Rheumatism, paralysis, or luxation, may thus cause the wasting of parts, which otherwise may be considered to be in a healthy state. In another sense, atrophy in old age, where all the organs undergo decay, is but the converse of growth which characterizes the early periods of life; but the phenomena which accompany it, before the body has attained its full growth, and those which belong to the adult period, are totally different. In an adult, for example, if a limb wastes, its length is not diminished; while, on the contrary, in the child, the growth not having attained its full term, the limb loses not only in bulk but in length also, so that in a few years the difference, as compared with the sound member, may amount to several inches. The treatment suited to atrophy must depend on the causes that have produced it, being itself a symptom, rather than a specific disease.

ATTITUDE, the position, or situation of the whole, or part of the body. The effect of habitual vicious attitudes is strikingly illustrated in the deviations of the vertebral column, as well as in many of the displacements of our organs; and the simple inspection of a part or limb is often sufficient to enable the surgeon to detect a hernia, fracture, or luxation. This term is also employed by continental writers in reference to the positions in which the patient, the surgeon, and his assistants, are placed for the performance of an operation. Position is also of much importance in aid of mechanical means employed to promote union in injuries attended by solution of continuity, or to afford support where accurate coaptation of parts is required.

AUSCULTATION. (Lat. *ausculto*, I listen.) This word is used to signify the mode of investigating the healthy or diseased state of an organ by the sounds which the part may be made to communicate to the ear.

In forming a diagnosis in affections of the heart and lungs, auscultation is of the utmost value, and by the labours of Laennec and others, it has been brought to great perfection. In the derangement of other parts its application is by no means so important; yet no physician or surgeon would be justified in neglecting so useful an auxiliary, or in denying himself the advantages which it occasionally affords.

The term "auscultation" is most generally confined to the method of exploration in which the ear is applied to the part under examination, either immediately, or with an instrument (as the stethoscope) interposed. But the origin of the word, and the usage of some practitioners, will authorize the more extended meaning given to it above. In this enlarged sense it includes the study of every sound by which disease may be indicated, in any part of the body, whether heard by the naked ear, or by means of instruments. It, therefore, embraces *succussion*, *percussion*, and *friction*, together with the *mediate* and *immediate* application of the ear to the part affected. On each of these topics we shall make a few observations; chiefly with reference to surgical practice.

I. *Succussion*—consists in a sudden shake, or agitation, of the part affected, and is intended to elicit a peculiar splashing sound, which marks the existence of a liquid and an aeriform fluid in the same cavity. Should either the liquid or the air be absent, no sound will be developed: a fact which may be illustrated by shaking a bottle *filled* with water only, or with air only, or containing both.

This mode of diagnosis appears to have been practised at a very early period. Hippocrates, and his immediate followers, used it; but after their time it was neglected. Morgagni, indeed, and some others speak of it, but not knowing how to explain the occurrence of sound in one instance, and its absence in another, they considered it of little use to the physician, and inconvenient to the patient. It was reserved for Laennec to point out its utility, and explain its import.

There are but few cases in which succussion can elicit sound, because the combination of air and a liquid in the same cavity is a rare occurrence; and even where it does exist, the contents may not be in sufficient quantity to render their agitation audible. Pneumothorax usually presents the necessary conditions; so do the stomach and intestines, frequently, in their natural state; and so *may* an abscess in the lung, or elsewhere.

Pneumothorax most generally arises from the effusion of the contents of a tubercular abscess into the pleura; air is furnished from a bronchial tube, and purulent fluids from the abscess, and the serous membrane. The combination required is here present, and the walls of the thorax are well calculated to render the sound audible. Hence it is, that in this disease succussion was first practised, and it is still almost the only one in which it is used. When the symptoms lead us to suspect pneumothorax, succussion ought to be tried; and if the splash be heard, our conviction is complete. One or two sources of fallacy ought, however, to be guarded against; even when this pathognomonic sign is present, the peculiar sound might be caused by a tubercular excavation half-filled with matter. But such an abscess must be very large, and the pus must be very fluid. And a case of this kind is so rare that Laennec met with only one example of it. Even then, as abscess generally occurs at the top of the lung, and pleural collections at the base, the difficulty of distinction is greatly diminished, and may be totally removed by the previous history, and the other existing physical signs.

It is possible that an abscess in any other situation may happen to contain air as well as pus. Such cases have occurred[1], and in them succussion might be used. But they are so rare, and so likely to be marked by peculiar phenomena, that there would be no necessity for succussion to distinguish them.

The Hippocratic succussion was performed thus:—the patient was placed sitting on a chair, and his arms by his side. An assistant then, laying his hands on the patient's shoulders, gave him an abrupt and sudden shake, whilst the physician listened for the expected sound[2]. It often happens that the patient cannot be conveniently raised to the sitting posture; in which case we may, by laying the hands on the sides of the thorax, suddenly agitate that part sufficiently without raising the pelvis or shoulders from the bed. Very frequently the patient hears the sound himself, and can make it audible to the bystanders by a rotatory jerk of his body[1]. In cases of difficulty the stethoscope may be used to enhance the sound.

II. *Percussion.* (Lat. *percussio*, *per* and *quatio.*) This word is used to denote the act of eliciting sound from any part of the body, for the purposes of diagnosis, by gently striking with the fingers, or any other contrivance.

Substances, whether animate or inanimate, on being abruptly struck, are thrown into vibrations, which give rise to sounds, and these sounds may be used to ascertain the nature of the bodies, or the state in which they then are. It is easy to judge, for example, whether the body we strike be wood or stone, whether solid or hollow, whether empty or occupied with liquid. And, if accustomed to strike any substance, and mark the result, we should be able to detect very slight alterations in its form, texture, and other circumstances; a cracked vessel may be recognized by any one; an unsound piece of timber is at once detected by the artisan. And this principle, transferred to medicine, is the basis on which percussion rests.

We may suppose, that so obvious a mode of learning the state of an organ was practised in the earliest ages of medicine. Yet there seems to be no distinct notice of it until Avenbrugger of Vienna published his essay on the subject in 1761. His book attracted little attention until Corvisart, fifty years after, translated it into French, and introduced the method into the hospitals of Paris. But it was the genius of Laennec, then the pupil of Corvisart, that bestowed on it its real importance. By combining its results with those of his own stethoscope, he proved it to be a grand auxiliary in the investigation of disease, and rendered a knowledge of its use indispensable to the judicious practitioner.

There are two modes of using percussion; the one by striking the part directly with the hand, or a convenient instrument; the other by striking a solid substance laid upon the part. The former is called *direct percussion*, the latter *mediate percussion*. The chest and abdomen are the parts best fitted for percussion; its application to other regions is very limited.

(*a*) *Chest.* In percussing this part, we may adopt either the direct or the mediate plan. In the *direct* we strike with the tips of the fingers, all arranged on the same plane, and kept close together by the thumb. The nails ought to be cut short, the strokes to have a good deal of force, and be sudden, yet short of giving pain, and the motion of the hand ought to be from the wrist. The part is to be kept tense by the operator's other hand, or by the position of the patient. If the back of the thorax be under examination, the patient leans forward, stoops his head, and crosses his arms. If the front of the chest, the arms may be thrown back, and the chin raised. If the side, then the corresponding arm is to be raised, and so on.

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[1] There was lately in the City of Dublin Hosp. a case in which a very large sac, close to the anus, contained air and liquid, and when shaken gave out a splashing resonance, easily heard at the other side of the ward.

[2] Hip. de Morbis, lib. ii. 45.

[1] Dr. Houghton's case. Dublin Med. Jour. vol. i. 319.

Different parts of the chest give out very different sounds in health. These differences must be attended to—for a sound which might be called healthy in one part would mark disease in another. The front of the thorax is clear, when percussed on both sides above; in the middle it is a little dull on the left side; and below it is a little dull on the right, and usually clearer on the left than at the top of the lung. The situations of the heart, the liver, and the stomach explain these varieties. On the posterior and lateral regions both sound alike, except at the lower part, where the liver causes a dulness on the right side, and the stomach a clearness on the left. More may be learned by comparing the sounds of opposite sides than in any other way. In regions which ought to be equally clear the slightest shade of difference often leads to the detection of formidable disease. This we see exemplified in early phthisis, when no physical sign can be made out except a little more dulness at the top of one lung than of the other. But in order to be sure that there *is* a difference, the utmost care must be taken in percussing. We must use the same force—we must strike corresponding points—we must have the line of our fingers either across the rib in both, or along the rib in both—and we must even take similar periods of the respiration, as the chest is more sonorous when filled by inspiration than after expiration.

It is better to percuss the ribs than the intercostal spaces; the sound is clearer, and the pain to the patient less. On the back direct percussion is of little use, except along the angles of the ribs, on account of the beds of muscles.

The interposition of a thin dress, as the patient's shirt, is recommended by Avenbrugger and Laennec. It takes away the clatter of the fingers against the skin, and gives the patient less annoyance. Avenbrugger also recommends a glove to be used with the same view. Laennec when percussing the back generally used the side of the stethoscope instead of his fingers. His cylindrical instrument answered very well for this purpose, but our light trumpet-shaped one would never do. The knuckle may sometimes be substituted for the fingers on the clavicle. Although very generally the *ends* of the fingers ought to be used, yet the pulpy *fronts* of them may, in some cases, be employed with advantage. By gently tapping with them the state of the walls can be better ascertained, as the force is not enough to make the interior vibrate. In this way a cavity in the lung, with its wall adhering to the thoracic parietes, may sound dull, whilst a more forcible stroke would bring out a morbidly clear sound.

Direct percussion is more easily studied on the chest than elsewhere, and this has induced the writer to enter more into its details, in the foregoing section, than might seem necessary for the purposes of surgery. The rules laid down may be transferred with little change to percussion in other organs.

Mediate percussion is the term used to denote percussion when practised with a solid plate of some kind interposed between the fingers and the affected part. The dress or a glove may be interposed in the *direct*, something more solid is required in the *mediate* form. M. Piorry who introduced the method uses a plate of ivory which he calls *plessimeter*[1], and on this, laid flat, and pressed against the part, he strikes so as to elicit the required sound. In this country the ivory plate is seldom used, but some substitute generally is, as a flat piece of Indian rubber, or piece of thick leather. Others[2] use a long piece of ivory, like a very thin paper-cutter, to one side of which a thin layer of elastic gum is fastened; the ivory surface is laid on the chest. Others again lay the first finger, or the first two fingers of the left hand, on the chest, as a pleximeter, and strike them with the right. This last is probably the best of the expedients. The fingers are ever ready for use, never left behind in mistake; they do not encumber with an additional instrument; they are usually of the proper temperature, create no clatter when struck, are composed of the same materials as the thoracic parietes, and accommodate themselves most conveniently to the inequalities of the surface. Some lay the back of the fingers on the chest, some the front. Piorry states many advantages which mediate percussion has over direct. 1st. Less pain is occasioned because the shock is interrupted and diffused, the force of impulse need not be so great, and it is applicable even where the surface has been irritated by blisters or ointments. 2nd. Direct percussion will scarcely cause any appreciable sound where a part is thickly covered with fat, muscle, gland, or effused fluids; yet under all these circumstances mediate percussion may be used with advantage. 3rd. Less art is required in arranging the fingers of the right hand, and less care in regulating the force and direction of the stroke[3].

(*b*) *Abdomen.*—Percussion of this cavity has been practised in all ages, and a judgment thereby formed of its contents. Hence the use of the word tympanitis in the oldest authors. But we are indebted to M. Piorry for directing attention to this mode of diagnosis in many diseased states of the abdominal viscera which had previously been supposed beyond the reach of the senses. Here, as in the chest, direct and mediate percussion may be used. The former is the older method, the latter is modern.

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[1] πλῆξις percussio, μέτρον modus.

[2] Dr. Marsh.

[3] See the works of Piorry, "De la Percussion Médiate." Par. 1828, and "Du Procédé Opératoire à suivre dans l'Exploration des Organs par la Percussion Médiate." 1830.

Direct percussion.—Much may be learned by gently tapping the parietes of the abdomen with the pulpy ends of the fingers. If air be accumulated in the intestines we shall have a clear tympanitic sound; if water in the peritoneal sac a dull sound. The colon in its healthy state usually contains air enough to sound somewhat tympanitic along its course; and the volume of the small intestines is neither quite dull, nor quite clear, but yields a sound of an intermediate character. The stomach sounds clear except after a meal, and the liver, projecting below the margin of the ribs, perfectly dull. So does the spleen. Anatomy teaches the usual position of all these organs, and, by practising percussion on the healthy abdomen, we become familiar with the sounds which they ought to give out when struck with a certain impulse. Percussion will thus become a most powerful help to inspection, palpation, and the other modes of investigation, and in many cases will be found the most important of all. A well educated ear will distinguish the sound given out by water in the bladder or peritoneum from that which a solid tumor yields, though both are dull. When a fluid is in the abdomen, however, we *feel* a fluctuation and do not so much require the evidence of the ear.

Mediate percussion is the method recommended by Piorry, and possesses some advantages over the direct. It may be practised, as on the chest, with a plate of ivory, wood, leather or Indian rubber interposed, or the forefinger of the left hand. From the greater difficulty of eliciting sound in the abdomen than the thorax a pleximeter is more necessary. If the viscera be tender they are less protected too, and more apt to suffer pain from direct percussion than in thoracic cases. Another advantage also must not be overlooked: a solid tumor in the abdominal parietes will give a dull sound on direct percussion, and may be mistaken for an internal disease. And, again, an internal tumor of considerable importance may be covered with intestines containing air, and thus escape notice; but if the pleximeter (or a substitute) be skilfully used both cases may be detected. By pressing the pleximeter firmly on the parietal tumor we shall, on percussion, hear the clear resonance of the healthy abdomen beneath. And in like manner the existence of a solid tumor under hollow viscera may be discovered by pressing firmly on the latter. In the same way a small quantity of fluid over which the intestines float will escape notice if direct percussion be used, but may be ascertained if the pleximeter be pressed steadily back to its level. Some experience is necessary to prevent mistakes arising from the natural projection of the spine, the situation of viscera, which varies a little in different positions, from the change of place which fluids undergo, and from the great difference in the condition of fat and lean persons, of the old and young, the male and female, &c. (See Abdomen.) Experience alone can give practically useful knowledge on these points, and therefore no opportunity of acquiring it ought to be neglected.

(*c*) *Percussion of other parts* is little used. On the head and extremities a case will seldom present itself in which much information can be derived from the practice. Tumors occurring in the neighbourhood of the abdomen ought to be percussed. If clearness of sound be perceived they will most probably prove to be herniæ. The contents of herniæ may be judged of by the same means. Indeed something of the nature of tumors generally might be ascertained if percussion were more practised. Thus a shade of difference may be detected between the sound of a knee-joint filled with fluid, or occupied with a morbid growth of synovial membrane, or with a fungous mass in which osseous spicula exist.

The existence of a calculus in the bladder may be ascertained by the ear; we may percuss it with the "*sound*," and not only feel but hear the stroke. Mr. Brooke has devised an ingenious method of rendering the noise of this stroke audible to an entire class of students. A small circular piece of thin board is used as a sounding-board; in the middle of which a wooden pin is fastened which fits the end of a catheter, and thus the sound of the latter against the stone is greatly elevated[1].

III.—*Friction* is another mode by which sounds are elicited. In every age this has been practised, and especially in surgical cases. It is applicable chiefly to fractured bones, the rough ends of which may be made to rub one against another, and produce a sound well known by the name of *crepitus*. This sound is always looked for in fractures, and is quite diagnostic.

It is much more easy to *feel* the crepitus than to *hear* it. That is—the rough grating of the bones is easily felt, but the sound is exceedingly feeble. The person who has hold of the bones thinks he hears the crepitus, which may totally escape the bystanders. This arises from the confusion which the operator's judgment makes between the two sensations, and also from the impression conveyed along the chain of bones from the fingers to the ear.

When a joint is injured and the synovial secretion altered in quantity or quality, a crepitation may be discovered which an incautious observer might mistake for the crepitus of fracture. But it is not so grating, and it wants the solidity and resistance which broken bones impart to the touch. This crepitation can scarcely, if at all, be heard without the stethoscope, but it is easily felt.—(See Fractures and Luxations.)

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[1] Med. Gazette.

IV.—*Immediate and Mediate Auscultation.*—At the head of this article, auscultation is used in its most extended sense. In this place it is limited to the mediate or immediate application of the ear to the patient's body, and it is in this confined sense that authors generally use the term. By adding the epithets *mediate* and *immediate* all confusion may be avoided.

(*a*) *Immediate Auscultation*, like immediate percussion, does not forbid that a cloth or a part of the dress should be placed on the patient's skin, it only denies us the use of any instrument by which the sound might be increased. Without this permission to cover the ear, decorum or cleanliness would in most cases prevent this method of examination.

When the ear is applied directly to the chest much information may be obtained, and they who are unable or unwilling to use the stethoscope ought, at least, to avail themselves of this help. It is inconvenient, however, in practice, and has given way to the stethoscope except in the case of children—with these it may be used advantageously; they are sometimes frightened at the sight of the instrument, and do not quietly submit to its application; but they will not, nor can they, so effectually oppose the direct application of the ear. In them, too, the sounds that are sought for are much more audible than in the adult.

(*b*) *Mediate Auscultation.*—For the discovery of this invaluable mode of exploration we are indebted to the genius of Laennec.

This great man having, by patient research and unrivalled acuteness, perfected one of the most splendid offerings ever made to medical science, thus simply and unpretendingly gives its history and presents it to the profession, "In 1816 I was consulted by a young woman labouring under general symptoms of diseased heart, and in whose case percussion and the application of the hand were of little avail, on account of the great degree of fatness. The other method just mentioned (immediate auscultation) being rendered inadmissible by the age and sex of the patient, I happened to recollect a simple and well known fact in acoustics, and fancied that it might, at the same time, be turned to some use on the present occasion. The fact I allude to is the augmented impression of sound when conveyed through certain solid bodies,—as when we hear the scratch of a pin at one end of a piece of wood, on applying our ear to the other. Immediately on this suggestion, I rolled a quire of paper into a kind of cylinder, and applied one end of it to the region of the heart, and the other to my ear, and was not a little surprised and pleased, to find that I could thereby perceive the action of the heart in a manner much more clear and distinct than I had ever been able to do by the immediate application of the ear. From this moment I imagined that the circumstance might furnish means for enabling us to ascertain the character, not only of the action of the heart, but of every species of sound produced by the motion of all the thoracic viscera, and consequently for the exploration of the respiration of the voice, the rattle and perhaps even the fluctuation of fluid extravasated in the pleura or pericardium. With this conviction I forthwith commenced at the Hospital Necker a series of observations which have been continued to the present time. The consequence is, that I have been enabled to discover a set of new signs of diseases of the chest, for the most part certain, simple, and prominent, and calculated, perhaps, to render the diagnosis of the diseases of the lungs, heart, and pleura, as decided and circumstantial, as the indication furnished to the surgeon by the introduction of the finger or sound in the complaints wherein these are used[1]."

The stethoscope is principally used in exploring the chest, and in the hands of the physician has removed many of the obscurities of the medical diagnosis. The *tactus eruditus* and the *eagle eye* of the surgeon are now nearly equalled in accuracy by the educated ear of the physician. A new sense is thus given to medicine; and where this is used not as a substitute for, but as a help to, the other means of diagnosis, the most valuable results follow.

It is well that every surgeon should be familiar with the use of the stethoscope, and be able to interpret all its signs; but as they relate chiefly to *medical* cases a full description of them here would be out of place. A brief notice of the application of this instrument to *surgical* cases is all that can now be given.

(1.) Foreign bodies in the trachea may be discovered by means of the stethoscope, when the symptoms are too obscure to point them out otherwise. A remarkable ronflement or sonoro-mucous râle is heard in the trachea when the body moves; and when it is quiet, the respiratory murmur usually ceases in one lung, (generally the right,) although clearness on percussion remains. These signs are well illustrated in the interesting cases given by Mr. M'Namara in the 5th vol. of the Dublin Hospital Reports[2]. See Tracheotomy.

(2.) *Fractures.*—Every surgeon has experienced the difficulty of feeling, or of hearing with the unassisted ear, the crepitus which he searches for in some cases of fracture, especially those near a joint, or when much swelling attends. On such occasions mediate auscultation will frequently afford him essential help. When the stethoscope is applied to fractures that have a well marked crepitus, the sound is increased so much as to be unpleasant to the ear: a rough crashing sound like that produced by "breaking a piece of wood across the knee." Even the slight motion in the fragments caused by the pressure of the instrument, without any attempt to move them, will often be enough to produce the expected sound, and thus the patient may be saved much pain and annoyance. The character of the sound will also convey much information to a practised ear. A harsh sound is heard from the hard bones, a softer sound from the spongy. A comminuted fracture gives a complicated and irregular clatter. A gurgling noise attends when the fragments are surrounded with fluid, and in compound fracture there is a sort of blowing joined with the crepitus. In all cases the sound is loudest near the fracture, and gradually diminishes as we recede from it. The crepitation, sometimes heard without fracture, about a joint or tendon, is easily distinguished from the true crepitus, by means of the stethoscope.

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[1] Treatise on the Diseases of the Chest, by R. T. H. Laennec, translated by Dr. Forbes. Lond. 1827.

[2] See also Dr. Houston's case, Dub. Med. Jour. vol. v.

(3.) *Luxations* will often receive elucidation from the stethoscope. The sound of smooth surfaces rubbing together, or the slight crackling of a bone moving among torn soft parts, is very characteristic.

(4.) *Aneurism.*—In cases of aneurism, especially those that are internal, the stethoscope may be made use of with advantage. In general a rasping, sawing, or bellows-murmur will be heard in the seat of the disease. It is true that any tumor pressing on an artery will occasionally give a similar sound, but the murmur extends farther along the vessel in the latter case than in the former. In the aneurism, too, the murmur will be heard on all its sides, even when pressed off the course of the artery, but not so in any other tumor. The sounds alluded to are not, however, always to be met with, even in aneurisms. Much will depend on the state of the sac, which if constantly distended by pressure of blood, or incapable of collapse by reason of its coagula, may not give out the usual *bruits*. In such a case the bruit will sometimes be rendered audible by taking off the hydrostatic pressure by a change of position from the erect to the horizontal[1]. In thoracic aneurisms the pressure of the tumor on a bronchus may cause the absence of respiratory murmur in one lung or a part of it, whilst the normal clearness on percussion remains. This symptom is of much importance.

(5.) *Serous inflammations.*—When two serous surfaces in an inflamed state rub together, a creaking sound, like that of new leather, is occasionally heard. This has been noticed in the pleura, pericardium, and peritoneum. It ought to be looked for in other serous and synovial membranes, in herniæ, &c. The hand can sometimes feel this *frottement*, but it is rendered very audible by the stethoscope. In order to its production it appears necessary that a *certain* quantity of lymph should be effused on one of the surfaces. If there be no lymph it is not heard, and if there be much it disappears. Its value in diagnosis is considerable[2].

(6). *Pregnancy.*—Mediate auscultation has been much used of late by accoucheurs, in judging of the existence and the life of a fœtus in utero. The *placental soufflet*, and the pulsations of the fœtal heart, are peculiar sounds, which cannot be mistaken. (See Pregnancy.)

(7). *Lithotomy.*—In sounding for urinary calculi the application of the stethoscope to the pubes or sacrum, may remove the surgeon's doubts as to the existence of stone in the bladder. The loud clear sound of calculus, the dull sound of a fungus, and the sort of pumping noise occasioned by moving the sound about in an empty bladder, may be easily distinguished, one from the other, by mediate auscultation, though these different conditions often embarrass the surgeon who trusts to the touch alone.

(8). *Tympanum and Eustachian Tube.*—Laennec says, " If we apply the stethoscope upon the mastoid process of the temporal bone, while the patient inspires forcibly with the nostril of the same side (the other being closed with the finger) we perceive a blowing sound, indicating the penetration of air into the mastoid cells. If there is any moisture in the Eustachian tube, or tympanum, we perceive a gurgling very like that of the mucous rattle ; and if the mucus happens to obstruct the tube all sound ceases. From this and other analogous facts we may ascertain the patency, or obliteration, of the Eustachian tube, and may thus be enabled to determine more particularly the cases in which it is proper to attempt curing deafness by throwing injections into this, or by perforating the membrane of the tympanum."

For some further particulars on the application of the stethoscope in surgical cases, see Lisfranc's " Mémoire sur des nouvelles Application du Stéthoscope," or Alcock's translation of it.

(*C. Benson.*)

AVULSION (*avulsio, arrachement*). Although this term is not in general use by surgical writers, it is here intended to designate the forcible separation from each other of parts of the body which were previously, more or less, intimately united ; the traction being carried beyond their normal extensibility, and a lacerated disunion being the result.

Avulsion may be the consequence of an accident ; or, it may constitute a part, or the whole, of an important surgical operation ; under which divisions we shall arrange the few general remarks we have to make on the subject.

I. *Accidental Avulsion.*—All parts of the body, but particularly the extremities, are prone to this injury ; and in manufacturing communities, where machinery is extensively employed, it is both frequent in its occurrence, and often dangerous, if not fatal, in its consequences. The force required to effect a complete separation, or disruption of the parts, will vary in different individuals, and in different parts of the same body. When first applied, the loose folds which exist, more or less, in the soft parts are effaced ; then the elementary fibres are stretched; and, if the force be violently or suddenly prolonged, their power of cohesion is overcome, and rupture takes place. When it is applied cautiously, and increased slowly, as in reducing a dislocation, it may be carried to a considerable extent without laceration; but, if the same degree of force were used suddenly, serious injury would be produced. It is, therefore, not only the amount of the traction, but the suddenness of its application, which effects the avulsion, and, in some measure, determines the point at which the rupture occurs. Thus, a limb may be caught by machinery immediately above the ankle or wrist, and the separation take place near the knee or elbow. It also happens, that the integuments and bone may be torn across and fractured at the exact point to which the force has been applied; but that some of the muscles, or tendons, shall be disunited at a greater distance. We have repeatedly seen fingers, and especially the thumb, forcibly torn off, their flexor and extensor muscles separating at, or close to their origin.

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[1] Dr. Corrigan.—Dub. Med. Jour. vol. ii.

[2] Dr. Stokes.—Dis. of Chest.

When the accident occurs, all the parts which compose the organ or limb to which the force is applied do not give way simultaneously, or equally. This arises from the difference in their natural structure and extensibility. The skin frequently resists force which has been sufficient to tear across muscles and arteries. Flambert relates a case of dislocation of the elbow, which was reduced by seven assistants using violent extension. The muscles, and other soft parts near the elbow, were extensively lacerated, so as to produce a deep groove, without injury to the common integuments[1]. We saw, some years ago, the brachial artery, and several of the muscles of the arm, torn, in the reduction, by unwarrantable force, of a dislocation of the humerus into the axilla. The skin was uninjured, which, with the exception of the bone, the limb being afterwards amputated, was the only part that had escaped. The cellular tissue, although very distensible, may be easily lacerated, so that we frequently find both its subcutaneous and intermuscular layers torn and injected with extravasated blood, whilst the other parts are unaffected. The muscles possess a high degree of contractility, and are the chief cause of resistance to the force employed, yet, having much less tenacity and force of tension than most of the other tissues, they more readily give way to sudden and violent traction. It sometimes happens, however, as has been alluded to in cases of avulsion of the fingers, that the tendons, and not the muscles, are torn. The arteries and nerves are found to bear a greater degree of extension with impunity than the muscles. The former may be drawn out until their coats have become greatly attenuated before they are lacerated; and then, it is always observed, that the inner coat gives way first, and next, the middle one, while the external or fibro-cellular layer continues longer to resist the force employed. The fracture of the bone is generally transverse; and if the force has been violent, it may project, more or less, beyond the soft parts; but its extremity is seldom spiculated.

The most remarkable point in the history of these accidents is, the absence of hæmorrhage. When an artery is lacerated, or forcibly rent asunder, little or no blood is lost. The usual process of injection and coagulation of the blood, with retraction and annular constriction of the vessel, takes place. The external clot forms rapidly, and the internal one is large and extensive; but as some time must elapse before these can form, they may obviously assist in preventing secondary hæmorrhage, but they can afford little or no obstacle to the loss of blood at the time of the accident. Nor can the retraction of the torn artery exert much influence, because this is not nearly so complete as when the vessel is simply cut across; on the contrary, the toughness and elasticity of the coats of the artery enable it to resist the force employed, and prevent its giving way until after it has been greatly elongated. We, therefore, observe that the torn artery does not retract itself completely, but that a portion of it, varying from half an inch to one inch and a half in length, projects beyond the surrounding soft parts, or hangs pendulous from the face of the stump. Various explanations of this occurrence have been given. That of Béclard appears the most rational. He states that the obstruction to the egress of blood depends, in a great measure, on the lacerated inequalities of the inner coat of the artery. We have, on two occasions, been enabled to verify this opinion, by accurate examination. One of the cases was admitted into the Glasgow Royal Infirmary; and the other occurred in private practice. In both an arm was torn off by machinery. One lived twelve, and the other thirty hours. The inequality of the inner coat of the brachial artery from laceration extended up along the vessel about an inch and a half from its torn extremity. It was, in several places, partially detached from the middle coat, so as to form several small projections, which almost completely filled the calibre of the vessel, and must have afforded not a single, but a series of obstructions, to the effusion of blood. In both cases the artery projected about an inch and a quarter beyond the muscles; its extremity was ragged, and its cavity apparently obliterated, so that not a drop of blood escaped. No pulsation could be felt in the pendulous portion, but immediately above it was distinctly recognized. On dividing the artery close to the face of the stump, a jet of blood, corresponding to the size of the vessel, was thrown out, showing distinctly that the previous absence of hæmorrhage was to be attributed to the lacerated inner coat, and annular contraction of the artery. There was no external clot present, nor was there any external pressure on the projecting, which was evidently the obstructed, part of the artery.

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[1] Répertoire Générale for 1827.

When an extensive part of the body, such as a limb, has been separated by avulsion, the shock to the nervous system, which is the usual attendant on serious injuries, is induced. This proves occasionally almost immediately fatal. In many cases, however, the symptoms at first are less prominent, and there is much less pain experienced than in other injuries not so serious. This may probably depend on the sudden and forcible manner in which the injury is produced. In the well-known case of Wood the miller, as detailed by Cheselden in the Philosophical Transactions, the arm was torn off, at the shoulder, with such velocity, that the patient was not aware of the accident till he saw his arm moving round on the wheel. A boy in a cotton-factory had his fingers entangled in the machinery, which was in rapid motion. The occurrence was immediately observed by an adult workman, who rushed to his assistance, but so incautiously, as to become himself the chief sufferer. The boy escaped with the loss of his fingers, and the man had his hand torn off above the wrist. He was aware of being injured, but did not know for some time that the hand which he saw hanging on the machinery was his own. A wealthy merchant of Glasgow was riding quickly on horseback, and the night being dark, he came suddenly upon a horse and cart on the road. He threw out his hand against the opposing horse to push it from him, and was not aware till he had gone to a considerable distance, that his thumb was torn off. The carter was not a little astonished next morning to find a thumb and a long tendon attached to it, sticking in one of the links of the harness.

The *local* appearances of an extensive avulsion, are those which characterize lacerated wounds; they will, therefore, be more appropriately considered under that head. It is sufficient for our present purpose to state, that the wound thus produced is jagged and irregular, especially when the injured parts consist of a variety of dissimilar tissues. In the scalp, which frequently suffers from this accident, the edges of the wound are often as smooth and clean as if formed by a scalpel.

Besides the nervous shock consequent on the injury, and its usual concomitants, various secondary, or symptomatic affections, may supervene. In one case, avulsion of the thumb was followed by fatal tetanus. In three cases of avulsion of the leg, retention of urine took place, requiring the daily and continued use of the catheter. In one of these only was there any reason to suppose that the spine was injured. This patient was admitted into the infirmary on the 5th of July, 1831. A few hours previously, while asleep in the flour-mill in which he was employed, two of his fellow-workers, for the purpose of awakening him, fixed a rope to his right-ankle, the other end of which was attached to a part of the machinery, then in motion. He was instantly pulled up to the roof, a height of eight feet, and his leg being caught by a revolving wheel, was forcibly torn from his body, a little below the knee. He then fell on his back on the floor. In our absence, amputation above the knee was performed by the late Mr. Angus. The retention of urine called for the regular use of the catheter; the stump suppurated; high irritative fever, with delirium supervened, and he sunk on the 20th day from the accident.

There are several successful cases on record, in which no regular amputation of the lacerated stump was performed, the ragged inequalities of the soft parts, and bone, being only removed. When the injury occurs at the shoulder or hip joints, no other treatment can be pursued; but if there is sufficient room left for a second amputation it ought to be performed. We cannot expect that such a lacerated wound, however nicely it may have been pared, or accurately closed, can possibly adhere; the contusion of the parts will not only interfere with this desirable termination, but may lead to gangrene, to profuse suppurations, projection of the bone, or secondary hæmorrhage.

The torn extremities of the nerves sometimes become the seat and source of excruciating and intractable pains, which is seldom or ever observed when the lacerated parts have been amputated. This symptom we have uniformly observed after avulsion of the scalp, an accident occurring to women, and that not unfrequently, in our public works. There is at present in the infirmary a young woman who had about two-thirds of the scalp torn off, and the pericranium laid bare, her hair having been caught by machinery. The case is doing well; but she is subject, and has been so since the third or fourth day after the injury, to excruciating neuralgic pains of the head and face, especially on touching slightly the remaining portion of the scalp on the forehead and temples. Occasionally, these pains entirely disappear after the wound has cicatrized, in other cases, however, they continue ever after, and are a source of great suffering.

2. *Surgical Avulsion.*—This may be either simple or compound. The former constitutes the entire operation, as in the forcible removal of polypi; while compound avulsion forms one of the elements only of a more complex operation, which is commenced by incision, with more or less extensive dissection, as in the extirpation of deep-seated tumours before the separation of the disease, by laceration of its attachments, can be effected, and complete avulsion produced.

This operation has been employed in a great number of cases, a few of which we shall simply enumerate, leaving a detail of the mode of procedure, of the instruments to be employed, and of the practical results, to future articles in which they will come more appropriately to be considered. In the mean time we may enumerate, as the most common surgical affections to which avulsion is applicable,—the extraction of hairs from the eyelids, in certain diseases of these parts; of the nails of the toes and fingers; of mal-placed, supernumerary, or carious teeth; of nasal, antral, pharyngeal, aural, and uterine polypi; of enlarged tonsils, of carious, or necrosed bones, from the tarsus, metatarsus, and toes, and from the carpus, metacarpus, and fingers, and in the extirpation of tumours, and enlarged glands, both deep-seated and superficial.

In some instances avulsion is employed, because it affords the speediest and most effective method of removing the disease; and on other occasions, it is had recourse to for the purpose of avoiding the loss of blood, especially in the extirpation of parts, which, from their deep position, and vascular connexions, might, under the ordinary method of excision, be followed by profuse and troublesome hæmorrhage. This procedure is founded on the fact already noticed, that an entire limb may be separated by force, and no bleeding take place from the lacerated vessels. It can only be safe to adopt this in surgical operations, when the vessels connected with the part to be removed are not of large size, or when they cannot be readily secured by a ligature, as in the extirpation of tumours from the axilla, or behind and below the angle of the jaw. We are aware that torsion has been successfully applied to large arterial trunks; and that in the removal, by avulsion, of deep-seated tumours, we have a combination of torsion with traction; but still we cannot assure ourselves that the force employed to tear out a diseased gland from a deep cavity, will insure the same immunity from after hæmorrhage, by effectively lacerating the artery, as would be the case, were the vessel on the face of a stump, and fairly within the control of the forceps. It must be acknowledged, however, that hæmorrhage rarely happens, either as an immediate, or remote consequence, of the forcible extraction of deep-seated tumours, provided the torn vessels are surrounded by, and enabled deeply to bury themselves in, loose cellular texture. But it is otherwise, when the tumour is situated near a bone, and is firmly adherent to muscular or fibrous texture, no layer of cellular tissue intervening. The force required for its removal from such a situation is not only greater, but the chances of hæmorrhage occurring are so increased, as to call for either the application of ligatures to the lacerated arteries, or the use of firm and steady pressure.

(*John Macfarlane.*)

AXILLA, the arm-pit, is a hollow situated between the upper part and inside of the arm, and the corresponding surface of the chest. Anatomists, however, no longer limit the signification of the word axilla to its strict meaning, the depression which the skin presents when it dips between the great pectoral and latissimus dorsi muscles, but extend it to other important parts, which are found from the skin of the arm-pit to the lower border of the clavicle and first rib. With this extension the term axilla comprehends an important region, which is principally formed, anteriorly, by the larger and smaller pectoral muscles; posteriorly, by the subscapular, the teres major, and a portion of the latissimus dorsi muscles; inwardly, by the serratus magnus, intercostal muscles, and ribs; outwardly, by the shoulder-joint, and upper part of the arm; it is of a triangular shape; and within these boundaries lie the axillary plexus of nerves, the axillary artery and veins, with their several branches, lymphatic glands, and vessels. These organs pass through the middle of the region, and are well-protected by the muscles which surround them. In this respect we observe a remarkable difference between the groin and axilla. In the former, the large vessels are situated very near the surface, uncovered by protecting muscles, and greatly exposed to injury; and, indeed, it may be asserted, that wounds of these vessels are much more frequent than those of the upper extremity. In compensation, however, for this apparent negligence in the situation of these vital vessels, their superficial posture gives the surgeon great facility in applying remedies for the cure of their injuries; while the labour of operating upon the axillary vessels, which, from their being so deeply imbedded, as to present much difficulty in approaching them, is often extremely embarrassing.

In this article we shall not follow the example of recent writers on surgical anatomy, who describe the various operations and diseases incidental to this region; subjects too important to be treated briefly. We shall, therefore, merely give a plain and practical description of the axilla. The outward configuration of the arm-pit is extremely variable, owing to its being changed by every displacement of the arm. Thus, when that limb is raised above the head perpendicularly, the hollow of the axilla almost disappears, its surface presenting nearly a plane; while, on the contrary, if the elbow be brought forward towards the sternum, the arm-pit then forms a deep hollow, and allows the fingers, when pushed upwards, to feel the head of the humerus. The arm-pit is much deeper in the male than in the female subject; because in the former the muscles are larger, and more prominent, and there is less adipose tissue to fill it up, while in the latter the muscles are much smaller, and a greater quantity of fat occupies the space; in youth, for the same reasons, the axilla is quite shallow, when compared to that of the adult subject. The skin in the arm-pit of the adult is generally covered with hair, which rarely attains any length; the skin is very sensitive, and of a deeper colour than that of the surrounding parts; it is very thin, and forms folds in certain postures of the arm; it is likewise supplied with small glandular organs, which secrete a fluid of a particular odour, and of an alkaline nature, which is sometimes very abundant, and sufficiently powerful to discolour and act upon the garments with which it comes in contact. This secretion is sometimes so considerable as to present a most troublesome disease. The skin about the middle of the arm-pit is quite firmly attached to the subjacent surface, from which it cannot be separated. This peculiarity was first pointed out by M. Gerdy, who lays great stress upon this fact, which will receive future notice.

On account of the numerous vessels, nerves, and glands of the skin of the arm-pit, it is extremely subject to disease, and cannot bear much pressure or irritation; hence it often occurs that much inconvenience is produced by the application of a bandage, or a pad, to this region. Immediately beneath the cutis we find a layer of cellular and adipose substance, which covers the front of the great pectoral muscle, and turns round its lower border, where it loses itself with the fat in the arm-pit. This subcutaneous membrane, which has been uselessly and unnaturally divided into several strata, by certain anatomists, whose chief aim appears to be the complication, and subdivision, of all the membranes of the body, varies considerably in different subjects: in meagre subjects it is merely cellular, and presents a thin, whitish, and semi-transparent layer; in fat persons, on the contrary, it is thick, fills up all the hollows, or spaces, between the muscles, and its membranous cells are distended by adipose substance. This membrane is a part of the common subcutaneous membrane of the body, and is continued with the surrounding layers, which cover the neck, the shoulder, the chest, &c. This membrane gives insertion to some of the fibres of the platisma myoides muscle, and receives numerous branches from the superficial plexus of nerves of the neck. The cephalic vein, likewise, is partly imbedded in its substance. This tissue is much more abundant in the female than in the male subject; it is sometimes the seat of inflammation, producing abscesses, but which are not dangerous, on account of their being superficial, and having more difficulty to point towards the deeper parts of this region, than to the surface, which is the contrary to what takes place, with an accumulation of pus, situated beneath the great pectoral muscle. The form and dimensions of the great pectoral muscle require little notice here; the oblique direction of its upper fibres, which arise from the sternum, ribs, and inner half of the clavicle, and descend downwards towards the axilla, is worthy of remark, as guiding the surgeon's scalpel in cutting down upon the axillary artery; and which also enables him to distinguish this muscle from the lesser pectoral muscle situated beneath, whose fibres have a different direction, being oblique from below, upwards to the corocoid process of the scapula. I saw a very intelligent surgeon quite uncertain whether, in cutting down upon the axillary artery, he had divided the whole of the pectoralis major, or had not yet reached the smaller pectoral muscle; while, if he had paid attention to the course of the muscular fibres, all his embarrassment would have ceased. Many surgeons recommend making the incision, for the purpose of putting a ligature upon the axillary artery, along the space which is said to exist constantly between the great pectoral and deltoid muscles. I have sometimes seen these two muscles so closely connected in their upper part even, as to defy their being separated, especially in the living subject. Generally, however, there does exist a small triangular space between these two muscles, whose basis is represented by the clavicle; it is this absence of muscular fibres which causes a slight depression immediately below the clavicle, which is very perceptible in thin persons. It is here, also, that compression of the axillary artery is most easily performed. But, notwithstanding the authority of John Bell, the vessel is much more effectually compressed above the clavicle, and attended with less pain to the patient. It must be remembered, when making the incision between the pectoral and deltoid muscles, that the cephalic vein runs along this course, and may be injured. I assisted my friend M. Roux in this operation, where, however, the cephalic vein was not even seen; the ligature of the artery was soon performed, and was followed with complete success, notwithstanding that this skilful surgeon pursued his usual mode of operating for aneurism, by first placing a small roller of adhesive plaster upon the artery, tying them tightly together by means of a broad flat ligature, in Scarpa's style, except that Mr. Roux allows the ligature to come away of its own accord. Through the triangular space abovementioned the pectoral muscles receive the anterior branches of the axillary artery, thoracica externa, or longior, which anastomoses with the surrounding acromial, inferior thoracic, intercostal, transversalis colli, and subscapular arteries. In performing operations upon this region, the surgeon will frequently be obliged to tie that vessel, or to twist it, which is soon done, and completely stops the bleeding. Applied to such vessels, torsion of the arteries is extremely useful, and answers the same purpose as the ligature, without the inconveniences of the latter. The origin of the fibres of the great pectoral muscle from the inner half of the clavicle, explains the necessity of keeping the arm close to the side of the chest, when the collar-bone is fractured, to prevent the pectoral muscle from drawing down the inner portion of that bone, and thus prevent the union of its two ends; for the like reason, in fractures of the neck and upper part of the humerus, the great pectoral and latissimus dorsi muscles ought to be kept in a perfect state of rest, to prevent any displacement of the ends of the fractured bone. The great pectoral muscle, on account of its thickness and resistance, will prevent an accumulation of pus from pointing forwards; and, hence, those burrowing abscesses, which extend in various directions along the cellular tissue and intermuscular spaces. This muscle is sometimes torn across, by violent contraction, or external violence. Mr. C. Benson says[1], "We have seen this accident occasioned by the passage of a railway-carriage over it, and marked by a deep depression, but without any laceration of the integuments." Beneath the great pectoral muscle we perceive the lower and front part of the little subclavius muscle, which lies along the border of the clavicle; it is covered by a pretty strong aponeurosis, which extends downwards over the axillary vessels and nerves. When it reaches the lesser pectoral muscle, it divides into two layers; one passes in the front, and the other behind it; they again unite, and the fascia is finally inserted into the skin of the arm-pit. The upper part of this fascia unites with the deep cervical aponeurosis; it forms a sheath for the subclavian muscle. This portion of the membranes is strong and resisting; it is continued to the coracoid process, to the capsular ligament of the humerus, to the deep fascia of the arm, and to the cartilages of the first, second, and third ribs. It is this portion of the aponeurosis, which has been called the costo-coracoid ligament, the ligamentum bicorne, caldani, the fascia axillaris, the "ligamentum suspensorium" of Gerdy, &c. &c. This aponeurosis becomes gradually thinner as it proceeds towards the arm-pit; it forms a sheath for the axillary artery and vein, spreads over the lesser pectoral muscle, and is, lastly, inserted into the skin. And Mr. Gerdy, who first laid stress upon this fact, says, that this fascia is the ligament of the skin of the arm-pit, which it pulls upwards. Although this membrane is not very strong, it may, nevertheless, prevent matter pointing towards the surface; and, hence, the importance of opening all abscesses of the axilla, as soon as possible, to impede those burrowing abscesses, which are so difficult and tedious to cure. In cutting down upon the artery, this deep fascia must be divided carefully upon the grooved director, which is first passed beneath it; for by cutting through it, without that precaution, the artery or vein might be easily injured by the knife. The pectoralis minor muscle is important, on account of its relative situation with the axillary vessels. Surgical anatomists generally divide the axillary artery into three portions; the first comprehends that part of the artery from the lower border of the first rib to the upper edge of the lesser pectoral muscle; the second, the whole extent of the artery, while under that muscle; and, lastly, the artery, from the lower border of the smaller pectoral muscle, to the lower edge of the latissimus dorsi, and pectoralis major muscles[1]. The axillary artery, thus defined, ranges downwards, outwards, and slightly backwards. When the arm hangs down by the side of the chest, the axillary artery describes a gentle curve, having its convexity turned upwards and outwards. The illustrious Camper has represented this position of the vessel in one of his bold and beautiful anatomical engravings. If the limb be separated from the body at right angles, then the artery presents nearly a straight line, is distant from the ribs, and lies close to the arm; on the other hand, if the arm be raised above the head to its full extent, then again the artery may form another bend, the concavity of which is directed upwards. The axillary artery lies deepest in the first part of its course, and gradually becomes more superficial as it proceeds downwards to its termination. The artery in this portion of its course is quite on the inside, and a little in front of the axillary plexus of nerves, which are easily separated one from the other; the vein, on the contrary, is in immediate contact with the artery; it lies on its inside, and when distended with blood, may entirely overlap the artery; as the vein is placed rather anteriorly to the artery it generally covers more or less of the inner part of its volume. The surgeon must take special care, when endeavouring to pass an aneurismal needle around the artery, to avoid wounding the vein which is so closely attached to it. The operator ought always to direct his needle, or directory, from the vein towards the artery, so as to prevent any fold of the vein being injured by those instruments, an accident which has sometimes occurred.

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[1] Dr. Todd's Cyclopædia of Anat. and Phys. p. iv. p. 359.

The nerves of the axilla are large, numerous, very complicated in their divisions, and at about the middle portion of the artery, they form a sort of sheath to that vessel, which renders its ligature in this situation very difficult. Mr. Harrison, in his excellent little treatise on arteries, seems to condemn the operation of tying the artery in its middle portion, on account of the small pectoral muscle covering it; but it is an easy matter to divide it, and thus lay bare the artery; in fact, the muscle does not constitute the chief difficulty of this operation; its division has been already proposed and executed on the living subject; but we must refer for a more detailed description of the vessels and nerves, with their respective branches, to the article Aneurism.

The axilla is abundantly supplied with lymphatic vessels and glands; some are dispersed about this region; others form a sort of chain, following nearly the course of the thoracic artery; and some surround the subscapular artery. The axilla is very frequently the seat of disease, for the cure of which some of the most important and difficult operations of surgery are required. The great quantity of cellular and adipose tissue, which not only exists in the arm-pit itself, but which fills up all the intermuscular spaces around, is certainly the most common seat of inflammation, producing abscesses which require speedy opening, to prevent their burrowing and devastating effects upon the surrounding tissues. Some abscesses are merely superficial, and may have their origin in the follicles of the skin, or superficial lymphatic glands; these also require being opened early, because the skin is very sensitive, and easily inflamed. In puncturing the deep-seated abscesses of the axilla, the surgeon should use the knife with great precaution; for it has sometimes happened, that the large vessels have been pushed forwards towards the surface, by the pus accumulated beneath them, and injured by the instrument; it is, therefore, prudent to feel for the pulsations of the artery before the knife is touched.

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[1] See Fig. 79, art. Aneurism.

Adipose tumours are frequently developed in this region; and although, at first sight, their excision, or removal, might appear difficult and perilous, on account of their surrounding connexions, they are generally pretty easily extirpated, and the scalpel is scarcely required after the incision of the integuments is made; these tumours are soon removed from their enveloping cysts. The lymphatic glands are very liable to partake of carcinomatous disease, when the mammary organ is affected with that disorder. The excision of these diseased glands is sometimes an operation of considerable anxiety to the surgeon, and requires the greatest caution, to avoid cutting or puncturing the large vessels; indeed, many operators prefer leaving some diseased glands behind, rather than follow them into the depth of the axilla; hence, may be explained the frequent recurrence of diseased cancerous glands of the axilla, consecutive to the removal of the diseased breast. As a general rule in all operations performed on this region, the surgeon should be careful in placing ligatures around the veins before their division, to prevent the rush of air into their cavities, which may prove almost instantaneously fatal to the patient. Several unfortunate cases of this description are already on record. The extent of injury done in wounds of the axillary region is frequently a matter of great uncertainty, from the quantity of loose cellular tissue, the emphysema, and ecchymosis, are sometimes very considerable, and render a correct diagnosis impossible. The axillary artery may be wounded, and at first give no positive signs of its injury, and, subsequently, a common aneurism may form, or an aneurismal varix, which the close connexion of the vein and artery easily explains. In punctured wounds, followed by hæmorrhage, requiring surgical aid, the operator may be uncertain whether to take up the axillary artery itself, or its larger branch, the subscapular artery; for there is no knowing where a pointed instrument may have passed, and what organs may be injured; and thus, until the incision of the integuments is performed, nothing is clearly seen. The axillary vessels and nerves have been completely torn through by the efforts made to reduce a dislocated shoulder-joint; and this ought to be borne in mind when the practitioner is engaged in an attempt to reduce old and very difficult cases of dislocation of the humerus.

(*C. Tarral.*)

B.

BALANITIS, from *βάλανος*, *glans*.—Inflammation of the mucous membrane covering the glans penis and forming the inner layer of the prepuce.

The epiderm of the mucous membrane of the glans penis, as well as that of the inner layer of the prepuce, more particularly in persons who have a long prepuce with a narrow aperture, is very delicate. The papillæ of the glans are, in some individuals, much developed; and the sebaceous follicles, termed glandulæ odoriferæ, situated behind the corona glandis, at the angle of reflexion which the mucous membrane makes between the glans and prepuce, are occasionally highly developed too, and throw out an abundant and an acrid secretion.

The extent of the prepuce varies greatly in different persons; in some it is so short that the glans is quite uncovered; in others, the glans is partially covered; and in others, again, the prepuce is so long as to conceal the glans, or, even, to constitute "phymosis."

The delicacy of the mucous membrane that covers the glans and lines the foreskin will be in proportion to the length of the latter, and this elongation, as it gives rise to an accumulation of heat and moisture seems to favour the development of the sebaceous follicles, and the activity of their secretion. However this may be, the chances of that secretion accumulating must of course be greater as the prepuce is more elongated. Where the glans is perfectly bared, no such accumulation can occur; and where there is phymosis, it cannot be perfectly obviated. Its quantity must therefore vary with the quantity of prepuce. In some persons we observe merely an appearance of scurfiness, looking like small scales adhering to the mucous membrane; while, in others, it seems smeared with a thick white paste, not unlike the ceratum plumbi.

The mucous membrane of the glans, and inner layer of the prepuce is liable to inflammation. This may be acute or chronic. It may occupy the whole of the mucous surface, or may be confined to a portion of it.

Acute Balanitis.—This is suddenly developed. The patient may have gone to bed without observing any thing amiss, and he may find next morning the complaint established.

There is a sense of itching, sometimes of smarting, rarely of sharp pain, within the foreskin, and particularly around the corona glandis. The prepuce is a little swollen, perhaps slightly reddened. From within it, there issues a puriform discharge, usually of dirty colour, often profuse, and sometimes offensive to the smell. It is generally thickened with sebaceous matter; occasionally it is thinner, and more like ordinary pus.

If phymosis exists, the discharge may be supposed to come from the urethra. Its orifice may pout, and the point of the glans may look red and tumid; but, on wiping it with lint, and making pressure along the course of the urethra, no matter is observed to issue from the latter, whilst similar pressure behind the corona, and on the glans itself, occasions its exit from the præputial orifice.

It may be difficult to determine whether the discharge proceeds from the surface of the mucous membrane, or from ulcerations behind the corona, or on the inner prepuce. But if ulcers exist, there is more tenderness on pressure; and when they have lasted for any length of time, hardness may commonly be felt. This latter symptom is not so characteristic as might, perhaps, be supposed. Warts behind the corona may co-exist with balanitis, and the sensation communicated to the finger, on making pressure from without, is so like what could result from indurated sores, that I have been more than once deceived by it. On the whole, it must be owned, that occasionally it is difficult to determine, in the first instance, whether the case is one of balanitis, or of sores, and the effects of remedies go a great way towards clearing up the question.

If phymosis is not present, the diagnosis of balanitis is simple. On retracting the prepuce, the glans, the gutter behind the corona, and the inner prepuce itself exhibits a patchy redness, dependent on partial abrasion of the epithelium. On examining the surface with a glass, the papillæ on the reddest spots may be observed to be denuded. A creamy substance adheres in places to the mucous membrane. This is the sebaceous matter, mixed, perhaps, with pus, and its aspect and odour are equally peculiar.

What the effects of this disorder would be, were it permitted to proceed unchecked, I cannot take upon me to determine. No doubt it often ends in the chronic form, and it may give rise to results, which are occasionally witnessed—extensive warts, ulcerations of the prepuce, and protrusion even of the glans through a morbid opening in the latter. But this is an extreme case.

Balanitis may be attended with inflammatory complications, such as inflammation of the absorbents of the penis, inflammation and enlargement of the lymphatic gland, on the pubes, or in the groins; suppuration in the cellular membrane of the penis is occasionally, though rarely observed.

The causes of balanitis may be enumerated without difficulty. The great predisposing cause is too long a prepuce, with acrid, if not retained, secretions. The act of connection is usually the immediate cause. If the venereal orgasm is frequently repeated, or if the secretions of the female are morbid, the occurrence of the disorder becomes the more probable. Severe exertions, a long walk, local friction, however occasioned, all tend to produce it. Free living assists their operation, and I have more than once seen balanitis follow a dinner-party, or a debauch, independently of obvious local excitement.

The treatment of acute balanitis is simple.

If the prepuce admits of retraction, the whole mucous surface should be gently, but effectually, washed with warm water, so as to remove the secretion that adheres to it. Lint, dipped in a solution of the liquor plumbi acetatis, of the strength of about two drachms to the pint of water, should then be applied, and retained. The lint should be changed twice or thrice daily, and the tepid ablution employed night and morning. Active aperients should be prescribed, and a cooling regimen, with quiet, should be recommended.

If there is phymosis, and the glans cannot be uncovered, warm water should be injected between it and the prepuce, so as to syringe out, as effectually as possible, the sebaceous matter. This should be followed by similar injections of the diluted liquor plumbi, and the latter ought to be repeated several times in the day.

Should inflammation of the absorbents of the penis, or of the lymphatic glands, be established, leeches, not to the body of the penis itself, but to the surrounding parts, may be requisite, and evaporating lotions should be had recourse to. General antiphlogistic regimen should be used as a matter of course.

If an abscess forms in the cellular membrane of the penis, it should be treated like an abscess elsewhere. If it occurs just behind the corona, which it sometimes does, it is very small, often not much larger than a pea, rarely equal in size to a marble. A not unfrequent situation is contiguous to the frænum. It may fairly be presumed that these small abscesses are immediately connected with the sebaceous glands. When opened, either by nature or the lancet, the aperture is apt to continue fistulous. It then becomes extremely small, and would seem to have no tendency to close spontaneously. But a fine heated wire introduced once or twice, readily effects a cure.

I observe that M. Ricord recommends the introduction of a stick of nitrate of silver between the prepuce and the glans. He sweeps it rapidly and lightly over the mucous membrane, and applies afterwards some lint, either dry, or dipped in water, or in the diluted liquor plumbi. He observes that one application may effect a cure, or it may be necessary to repeat it twice or thrice, at intervals of two or three days. It appears to me that this plan is not likely to be attended with any great advantages. If the prepuce can be retracted, and ablution, and the liquor plumbi freely used, the complaint is usually cured in a day or two, and very rarely lasts so long a time, as would seem, in some instances, to be occupied by M. Ricord's treatment. I have tried a strong solution of the nitrate of silver, but without such results as encouraged me to prefer it to the plan already recommended. If there is complete phymosis, (and this is the only troublesome form of balanitis,) it is not very clear how a stick of caustic could be *properly* employed. M. Ricord, however, speaks very highly of it, and assures us, that of all "resolvent" methods this is the most effectual.

Chronic Balanitis.—This may follow attacks of the acute form; but it more frequently occurs independently of it. Like acute balanitis, it presents itself in connection with complete phymosis, or with a partial investment of the glans by the prepuce. But acute balanitis can scarcely happen, unless that investment be considerable, while chronic balanitis is not uncommon, when the foreskin does not cover more than a third of the glans.

In acute balanitis the surface of the glans, as well as the inner layer of the prepuce are affected; in the chronic the complaint is usually limited to the inner layer of the prepuce contiguous to the corona, and the gutter immediately behind the latter.

This portion of the mucous membrane is red, tumefied, and moist. If there is much prepuce, the sebaceous secretion may collect; if there is little, with ordinary cleanliness, it will not. The surface is not usually abraded of epithelium; but after coition, or much exercise, or a debauch, it may become so. The tendency to "excoriations" in connection, is marked; and this very tendency predisposes the individual to venereal sores. The subject of chronic balanitis can scarcely indulge in sexual intercourse, without either an abrasion, or ulceration, or some other consequence of the extreme irritability of the part.

The affected surface is generally tender to the touch, particularly after the excitement of coition. I have seen the latter give rise to inflammation of the penis, and the small abscess behind the corona is common in cases of chronic balanitis.

When the disorder has lasted long, the mucous membrane behind the corona is thickened, warts are apt to spring up, the epithelium is easily abraded, and small ulcers, with a yellow surface, and slightly cupped, are occasionally observed, independently of previous connection. These ulcers appear to be similar to the sores that are not unfrequent on the mucous membranes of the lips and cheeks, and tongue, in persons with deranged digestive organs. They wear a similar aspect, looking as if a piece of mucous membrane had been picked out with the nail; and they are observed in similar states of constitution. However this may be, such sores on the prepuce do certainly arise spontaneously, and heal without entailing secondary symptoms. I have seen them mistaken for "chancres," and patients put unnecessarily on a course of mercury.

I am inclined to think, that persons who labour under chronic balanitis are peculiarly prone to that troublesome affection—herpes of the prepuce.

The essential cause of chronic balanitis is too long a prepuce. In some individuals, and particularly in those who commit excesses, sexual or dietetic, any degree of investment of the glans, disposes to irritability and chronic inflammation of the mucous membrane. This tendency may give rise to no material inconvenience, until connection is indulged in, and other irregularities take place. Then, chronic balanitis is apt to supervene.

The treatment may be palliative or radical.

The former consists in ablution with cold water every night and morning, the retention of lint behind the corona, dipped in the diluted liquor plumbi acetatis, or in a solution of the sulphate or acetate of zinc, an occasional application of the lunar caustic, in substance or solution, regulation of the secretions, and avoidance of excesses. If the cuticle is abraded, the black wash, or plain lime water, or a weak solution of the sulphate of zinc will remedy it. The ulcers to which I have already alluded, should be lightly touched every second day with the nitrate of silver, while the black wash may be constantly applied to them.

To the management of warts, it is unnecessary at present to advert.

It must be owned, that these means are far from effectual. While they are perseveringly used the complaint is kept in abeyance; but, if they are neglected, it generally reappears. The least excess lights it up; venereal intercourse will most probably be followed by it; excoriations are constantly occurring, and the annoyance is great.

The only radical treatment is circumcision, or the division of prepuce. The result of the latter operation is eversion of its inner layer, and complete exposure of the glans. The mucous membrane is no longer retained in a moist and heated state. Exposed to the air, and to contact with the clothes, the epithelium thickens, abrasions are not so easily occasioned, warts are not generated, and the liability to the action of the venereal poison is very materially diminished.

The operation is a very successful one; and in cases which have lasted for any length of time, circumcision, or division, is the only remedy to which confidence can be attached.

If the patient is willing to submit to circumcision, this is, if possible, more effectual than division of the prepuce. But it is also more severe, and I have found few who were willing to submit to it. In the majority of cases, it is really unnecessary, the mere division of the prepuce answering the purpose completely. But if the foreskin is very long and narrow, circumcision is undoubtedly preferable. Yet, even in this case, division of the prepuce commonly does well enough, and the flaps of integument that depend on either side, are ultimately so absorbed as to leave but little, if any unsightliness of the organ.

(*Henry James Johnson.*)

BALSAM OF COPAIBA, a species of turpentine, which is obtained by perforations made on the copaifera officinalis. Its action on the mucous membranes, more particularly those of the urinary organs, have caused it to be selected in the treatment of many of the mucous discharges of those passages, such as blenorrhagy, leucorrhea, catarrh of the bladder, hæmorrhoids, &c. In these cases, it is exhibited in doses varying from ten drops to a drachm, three times a day. Some practitioners prescribe it in gonorrhea from the very commencement, continuing its use at high doses till the suppression of the discharge, which is frequently effected in from three days to a week. Laennec used it successfully in large doses in a patient who suffered from articular pain and swelling following the suppression of a gonorrhea.

The taste and smell of this medicine is extremely disagreeable to many, and on this account some prefer exhibiting it by the rectum. For this purpose it is dissolved in mucilage, or the yolk of egg, with the addition of a little laudanum to quiet the gut, and cause it to be retained. Various modes have been resorted to, in order to disguise it when taken by the mouth; one of these is to convert it into a solid mass by mixing it gradually with a sixteenth of its weight of calcined magnesia. In a fortnight, the transparent paste or gum thus formed may be moulded into pills, and given instead of the liquid balsam; it is also exhibited in capsules[1], or united with soap so as to form pills. Dr. Thorn, an American physician, recommends the pure resin obtained by distillation of the balsam, in the dose of from ten to twenty grains three times a day. This treatment, he affirms, is often heroic on the second or third day. In catarrhal affections of the bladder, it has been prescribed in equal parts with the liquor potassæ, mucilage, and water, tincture of hyoscyamus being added. Although used in all stages of the mucous discharges from the urinary passages, it nevertheless is sometimes productive of inconvenience even in those cases. Copaiba is not only an irritant of the urinary passages, but in large doses a purgative, and indeed some practitioners suppose that its virtues in gonorrhea, &c. far from being specific, merely depend on the revulsive irritation which it produces on the intestines. In some cases, it is known to produce a sensation of tingling, and even of pain in the prostatic portion of the urethra. Some authors go so far as to state that it may give rise to inflammation of those membranes, and that it is only in this way, that it effects a cure. When its effects as an irritant become manifest, it will be proper either to discontinue its use, or to modify them by leeching, tepid bathing, camphor, or opium.

BANDAGE (*deligatura*, *deligatio*, *fascia*). Bandages are employed for the confinement of dressings and other surgical remedies in their proper situations, to restrain hæmorrhage from wounded blood-vessels by compression, retain in their natural position parts which have been displaced, and give support where it may be required.

With reference to their materials and formation, they are generally divided into two classes, simple and compound bandages; the first comprising the several dispositions of the roller, the second embracing all bandages of a complex character, such as the many tailed and uniting bandages, and those constructed with laces or buckles.

They are also classed according to their various uses under the heads of *confining*, *uniting*, *divisive*, *compressing*, *expellent*, and *retentive* bandages. In this article bandages which are of general utility, or at least which are adapted to a number of uses, will come first under consideration, afterwards those suited to particular purposes, distributing the latter for convenience under the several heads just mentioned; and, in order to convey more correct impressions of their application and intentions than mere description will afford, wherever illustration appears necessary, engravings are introduced.

The materials which enter into the composition of bandages, are rollers and compresses of various forms, handkerchiefs for slings and other purposes, belts of webbing or leather, secured by buckles or laces, generally substituted for particular combinations of the roller, and one or two tissues of a peculiar character. Simplicity of construction is to be adhered to wherever it is compatible with a perfect accomplishment of the end desired, and with this view, rollers and handkerchiefs may, in very many cases, supersede the employment of more expensive contrivances. M. Mayor of Lausanne has perhaps carried this principle to an extreme, in employing handkerchiefs alone in the formation of every variety of bandage. Many of his contrivances are more ingenious than useful. Figs. 122, 123, and 124 (*le carré long*, *le triangle*, *la cravate*) represent the forms in which he folds the handkerchief preparatory

Fig. 122.

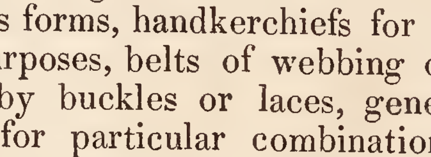


Fig. 123.

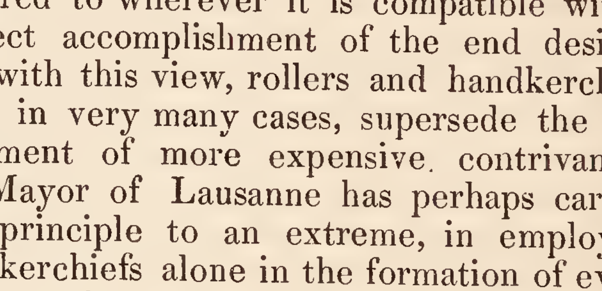
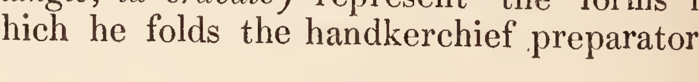


Fig. 124.



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[1] This method of enclosing this unpleasant medicine in capsules is very convenient. Those lately prepared by Messrs. Savory and Moore are so superior in every respect, containing more balsam, and are so flexible, that no difficulty is experienced in swallowing them.

to its application. Some few of M. Mayor's bandages will be introduced in illustration of his principle.

Rollers for ordinary purposes are bands of moderately fine calico, torn from a piece of the entire length required, as they must be free from joining, seam, or selvage, and rolled up into one or two heads. Unbleached calico will generally be found superior to the bleached, as it is softer and more supple. A cotton stuff of the texture of a thin stocking is woven expressly for rollers, and sold under the name of Churton's stocking bandage. It is more elastic than calico, and makes an excellent bandage for cases of anasarca, varicose veins, and chronic enlargements of the joints requiring support. Flannel rollers are sometimes employed, and on account of their warmth are well adapted to similar affections in elderly persons. The French surgeons object to calico, that it is too soft and yielding to afford a firm support, and prefer rollers made of linen.

Figs. 125 and 126 are single and double-headed rollers; their length and breadth is varied according to circumstances. The manner of rolling them up is a point deserving attention, as with a firm and compact head, the roller can be applied much more effectively. The terms head and tail of a roller are often used in a confused manner, and render the description of a bandage obscure. French writers distinguish the ends of a roller as its initial and terminal extremities.

Fig. 125.

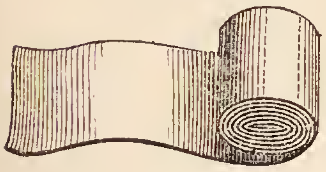
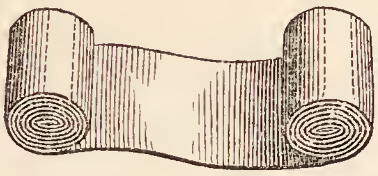


Fig. 126.



Compresses are portions of lint or linen folded in square, oblong, and other forms, of various sizes and thickness; they are employed to give solidity to a bandage, fill up inequalities of the soft parts beneath it, approximate the edges of deep wounds, prevent the accumulation of pus in the course of sinuses, compress the trunks of wounded arteries, &c.

The square compress, divided from the corners towards the centre, is called the Maltese cross (Fig. 127); it was formerly used for confining dressings to the ends of the fingers and toes, the penis, and to the stumps of amputated limbs, a practice now obsolete; but dressings cut in the same fashion embrace these extremities very conveniently. Oblong compresses are sometimes split at one or both extremities to answer particular objects, and are distinguished by the names of the single and double split-cloth or compress. The graduated compress (Fig. 128), is a variety of the oblong, and is made in the following manner; one border of a square piece of linen is folded over to produce a narrow plait, this plait is folded back upon the linen to form a second, somewhat broader than the first, and so on with each successive plait, until the square is reduced to an oblong compress, of considerable thickness along its middle line, and becoming gradually thinner towards each border. The graduation may be made to ascend from one side to the other, so as to retain the greatest thickness of the compress at the border where the plaits commence.

Fig. 127.

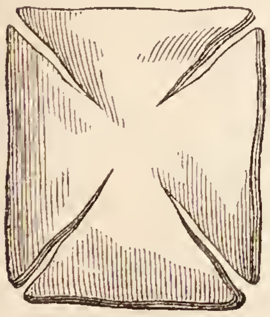
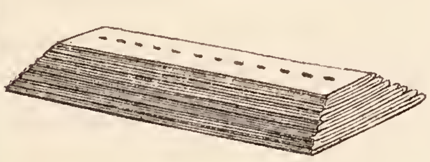


Fig. 128.



1. Bandages for general uses.—The simplest kind of bandage consists of the circular turns of a single-headed roller, each overlapping the other, and serves to confine dressings to the head and trunk.

The spiral bandage.—The next in point of simplicity is the spiral, of which two varieties are described, the creeping spiral (*spiral rampant* of the French), and the spiral with reverses (*spiral demi-couvert*). The former (Fig. 129), is nothing more than the spiral circumvolutions of a single-headed roller, the turns barely touching each other. It is used as a confining bandage to the extremities. The spiral with reverses (Fig. 130), fulfils a greater number of intentions than any other form of bandage, being used as a confining, compressing, supporting, and uniting bandage. The description of its application to the leg will answer equally well for the upper extremity. The initial extre-

Fig. 129.

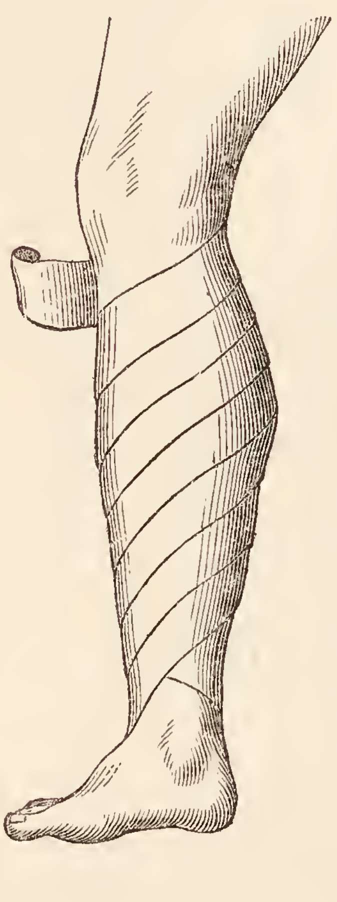
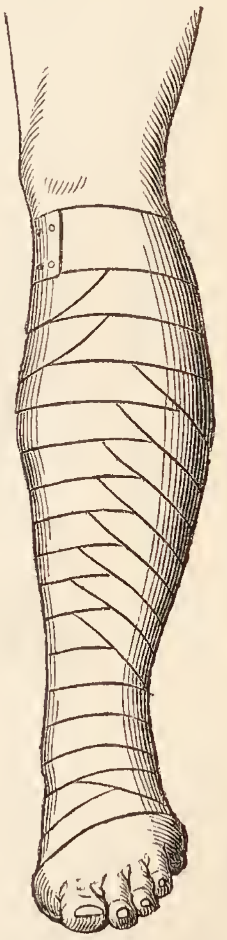


Fig. 130.



mity of a single-headed roller, six or seven yards in length, and from two inches and a half to three inches in breadth, is placed upon the inner ankle, and the foot encircled by one or two turns from within outwards ; the roller is next made to describe a figure of eight round the ankle and instep, and is continued spirally up the leg, each turn overlapping the upper third, or more, of that below it ; when it reaches the swell of the limb, a certain manœuvre is necessary to make it lie evenly ; as it mounts upward, the spiral direction of every turn ought to be increased somewhat, and the roller gently reversed, its internal surface becoming external, and superior border inferior. This reverse is repeated until the bandage has enclosed the bulky part of the calf, when its circular course is resumed ; the reverses must be made in the opposite direction, from below upwards, as the size again diminishes towards the knee. The chief difficulty in this bandage is the application of the roller smoothly to the ankle and calf, to produce equable pressure on the whole of the limb ; a narrow roller can be adjusted more closely to the ankle than a broad one.

The many-tailed bandage.—Several purposes for which the last bandage is applied may be more conveniently effected, under particular circumstances, by the many-tailed bandage. Fig. 131. shows its composition according to Pott ; Fig. 132 its application to the leg. Upon a longitudinal band of linen or calico, of the same length as the part for which it is destined, a number of cross-bands, long enough to take one turn and a half round the limb, are stitched a little obliquely, this arrangement causing them to fold over each other more smoothly. Every cross-band should overlap the lower half, or more, of the one above it. The bandage being placed under the limb, the foot is first encircled by the cross bands, which ascend gradually, the ends of each band embracing and securing that below it. It is chiefly employed as a supporting bandage in fractures of the leg and thigh, as it can be unfolded and reapplied without disturbing the limb. Also with compresses, as an expellent bandage, to prevent pus collecting in a sinus, and sometimes as a uniting bandage.

Fig. 131.

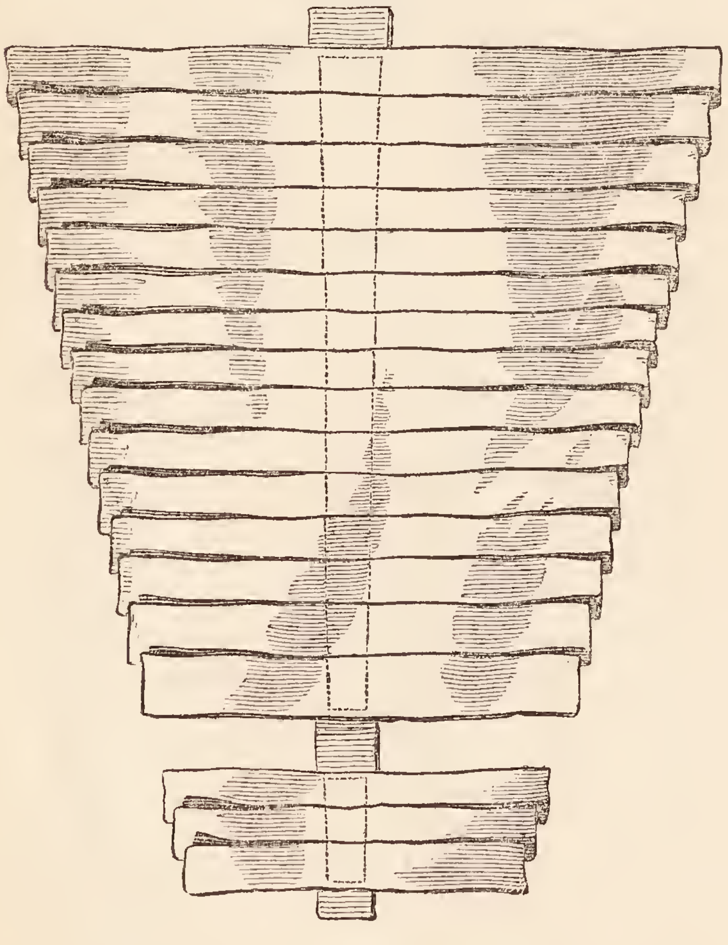
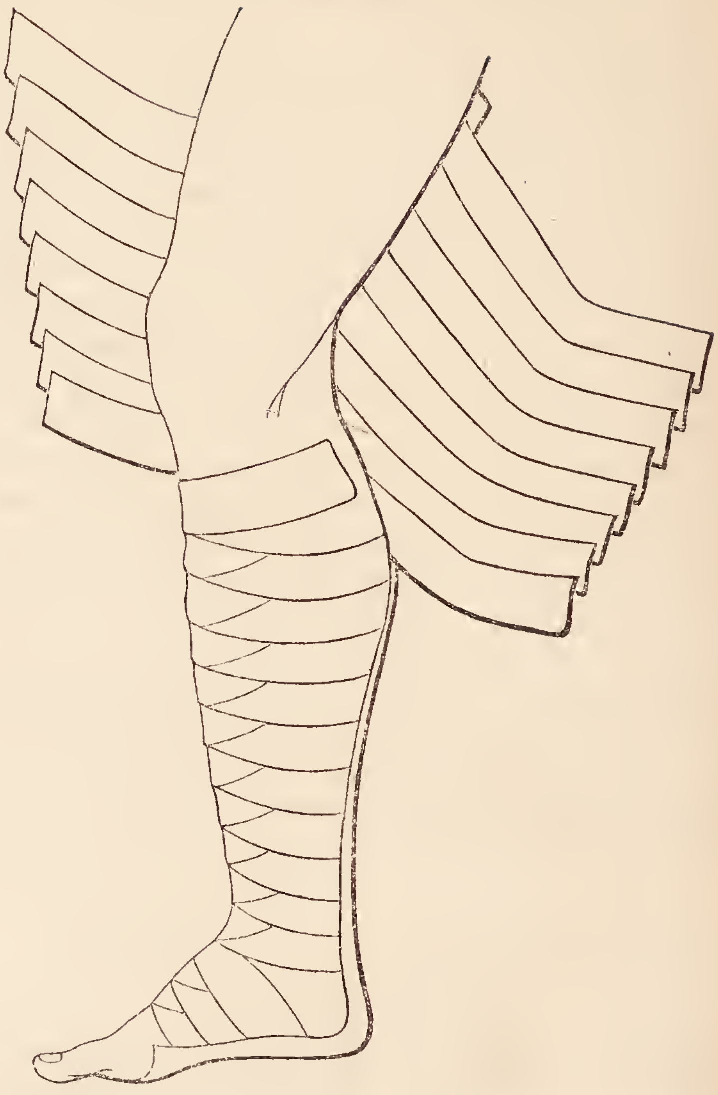


Fig. 132.

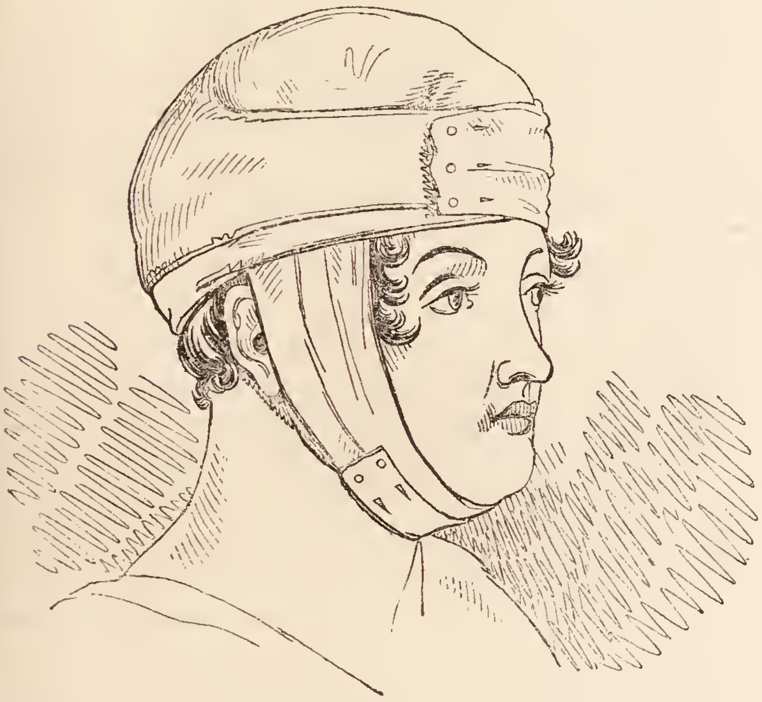


In compound fractures, Scultetus's is a more convenient form of this bandage ; it differs from it merely in the circumstance that the cross-bands are not sewed to the longitudinal band ; any one of them can therefore, be withdrawn if soiled, and replaced, without disturbing the limb, by stitching a fresh band to the end of the former, and drawing it under as that is removed ; the cross-bands may be spread with soap cerate, if more support is thought advisable.

2. Bandages for particular purposes.—*Confining Bandages.*—As a general rule they ought to be simple in their composition, and applied as lightly as is consistent with security, undue pressure having been frequently productive of serious consequences after great operations. Their forms are various in order that they may be adapted to the several regions of the body.

The Head and Face.—For the head, two simple confining bandages may be made with the handkerchief in the following manner. In the first (*capitium magnum*, Lat. ; *grand couvre-chef*, Fr.), the handkerchief is thrown over the head with the four corners hanging down; the front border is then furled up to the forehead, and its two corners carried back to be tied behind the occiput, while the posterior corners are brought forward, and tied beneath the chin. The second (*capitium triangulare*, Lat.; *couvre-chef en triangle*, Fr.), is the cap frequently worn by French women. The handkerchief is doubled corner-wise, folded round the head by its long extremities, and tied in a bow, enclosing the corners, which fall lightly over the crown. They are merely to be considered as substitutes for the common night-cap. The six-tailed bandage for the head (*linteum scissum*, Lat.; *bandage de galien ou des pauvres*, Fr.) Fig. 133. admits of being applied with greater firmness and security than the preceding. It consists of a piece of linen, about a yard in length and half a yard in width, split longitudinally, from either end nearly to the middle, into three portions; the centre being placed upon the crown, the middle tails are brought down and tied beneath the chin, the anterior tails are carried backwards and secured by a pin at the back of the head, and those from behind drawn forward and tied or pinned over the forehead. The central portion of this bandage, perforated with holes for the eyes, nose, and mouth, as seen in M. Mayor's handkerchief bandage for the same purpose, (Fig. 134) forms a convenient kind of mask for confining dressings to the face, the six tails meeting over the back of the head.

Fig. 133.



T bandages (see page 460) need scarcely be enumerated, as formerly among the confining bandages to the head, as their use is superseded by one or other of those already described. A double T bandage, made as follows, is sometimes serviceable for confining dressings to the nose. Upon a narrow strip of calico, one yard in length and half an inch wide, two other strips are stitched at right angles, leaving an interval of an inch between them; this interval being placed upon the upper lip, the ends of the transverse band are carried backwards and tied behind the neck, the two others are brought up on either side of the nose, crossed between the eyes, and their extremities being continued obliquely over the head, are attached behind to the transverse band.

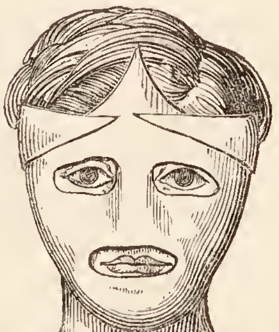
The *monoculus* and *binoculus*, two figure of 8 bandages formerly used for confining dressings to one or both eyes, may also be omitted, as their intentions are better fulfilled by a thin handkerchief passed lightly round the head.

The Trunk.—Topical remedies are confined to the breast by a four-tailed bandage (*funda, sive frondalis, quatuor capitum*, Lat.; *fronde à quatre chefs*, Fr.) made by splitting a piece of linen, half a yard broad, and long enough to encircle the body, from either end nearly to the middle, into two portions. The centre enveloping the breast, the two upper heads are carried over the opposite shoulder and tied; the other heads are passed round the chest, and secured beneath the axilla.

This bandage is also applied as a kind of sling to the chin (Fig. 149), to confine the hare-lip bandage (see *uniting bandages*); and in fracture of the lower jaw (see *retentive bandages*). In the older writers on this branch of surgery, it will be seen applied to a multitude of uses under the name of *lintium scissum* or split-cloth. (See Galen, Lib. de Fasciis.)

As a body bandage, the old napkin and scapulary (*scapulare cum mantili*) is well suited. It is simply a doubled napkin or towel passed round the trunk, the overlapping ends of which are secured by pins or tapes sewed to it; two bands stitched to the upper margin of the belt behind, are then brought over the shoulders, and pinned to the upper margin in front, to form the scapulary. Fig. 135. is

Fig. 134.



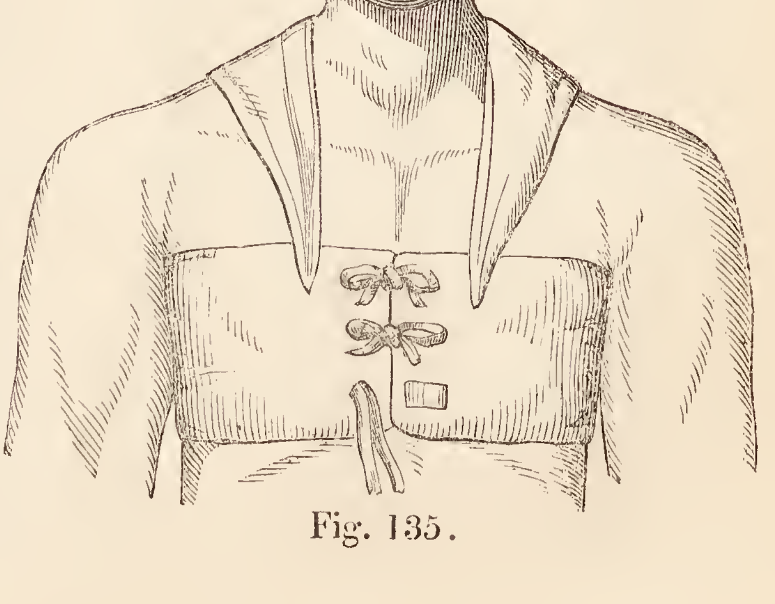
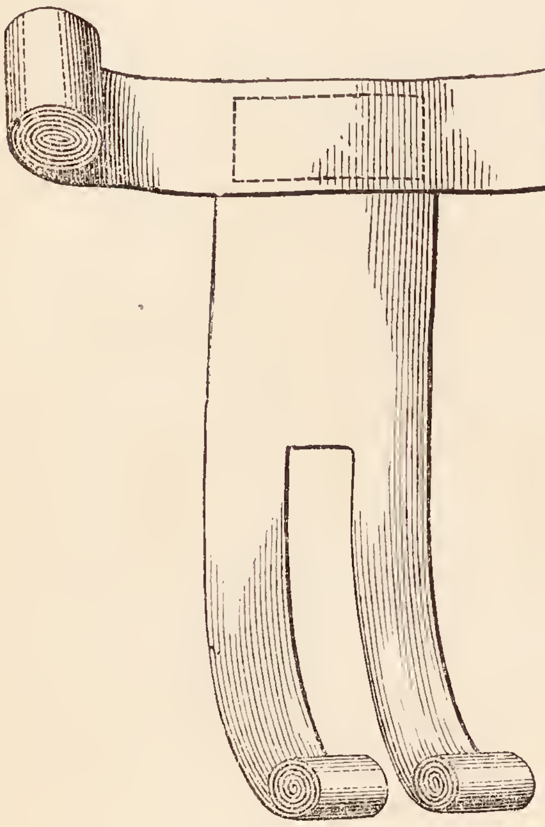


Fig. 135.

M. Mayor's napkin and scapulary ; the *carré long* encircles the chest, and the *triangle* forms the scapulary. When applied over the abdomen, thigh straps should be added. This bandage is also used for confining the humerus to the side, after reduction of a dislocation of the shoulder, the fore arm being supported in a sling.

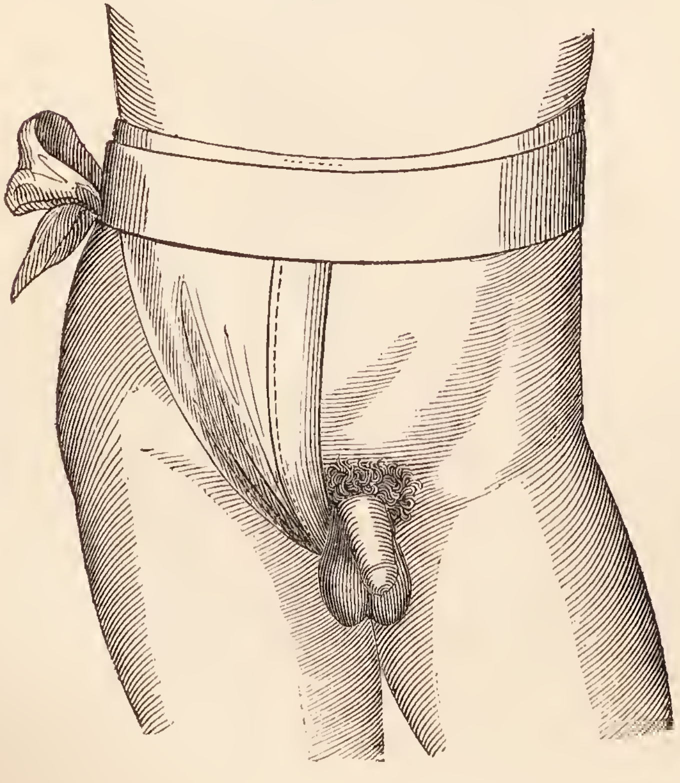
To the perineal region, the forms of T bandage are best adapted. Fig. 136 is the double T bandage, made by sewing a broad band, divided longitudinally, upon the middle of a short roller at right angles ; the latter is intended to surround the waist, whilst the divided band descends behind the pelvis, and its two extremities passing between the thighs, are brought up on either side of the scrotum to be attached to the roller in front. In the single T bandage, the perpendicular band is undivided.

Fig. 136.



The triangular inguinal bandage, (Fig. 137) is a variety of T bandage adapted to the groin. A triangular piece of linen or calico is stitched to the two portions of a single T bandage at their juncture ; the roller is passed twice or thrice round the pelvis and tied ; the descending band is carried between the thighs, drawing the triangular portion over the groin, and is attached to the back part of the roller.

Fig. 137.



The suspensory scrotal bandage (Fig. 148) is a variety of T bandage.

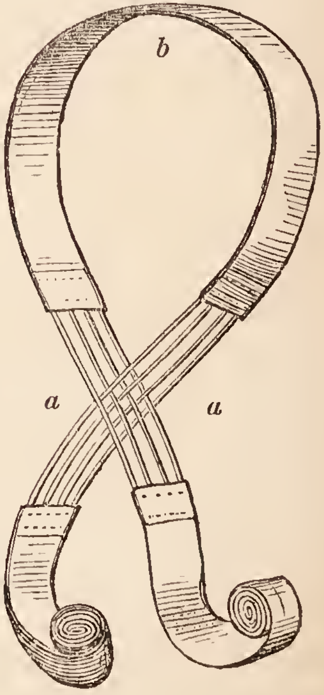
Uniting bandages.—Uniting bandages are not so much employed as formerly, but sometimes prove valuable auxiliaries to adhesive plaster and sutures, in maintaining the edges of wounds in contact, by restraining all motions tending to separate them. Their application ought always to be seconded by position, and in deep transverse wounds of muscular parts, the addition of a splint, to keep the limb in a perfect state of quietude, is advisable.

The spiral and many-tailed bandages (Figs. 130 and 132) may be included under this head, inasmuch as they afford a general support to parts in the neighbourhood of wounds, as to stumps after amputation, and in gun-shot wounds.

Another general form of uniting bandage, consists simply of a roller with one or more slits at a short distance from its initial extremity, which is divided into two or more tails to correspond ; compresses being applied on either side of the wound, the divided extremity is passed round the limb, the tails drawn through the slits so as to approximate its edges, and the remainder of the roller continued lightly round the limb to complete the bandage.

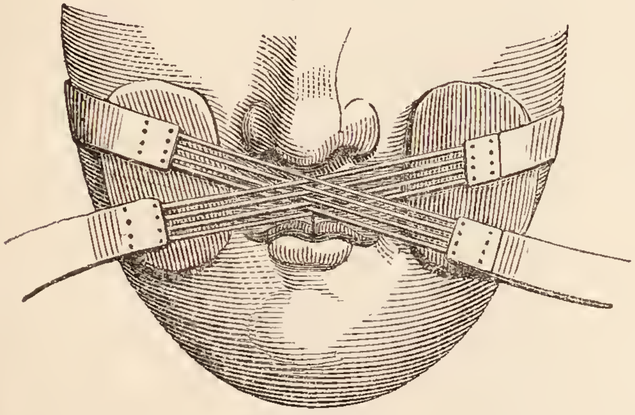
Particular Uniting Bandages.—Several uniting bandages have been devised to second the action of the twisted suture, in preserving the edges of the wound in contact, after the operation for hare-lip. A double-headed roller, about half an inch in width, applied in the following manner, will answer this purpose. A thick compress having been laid upon each cheek, about an inch from the commissure of the lips, the middle of the roller is placed on the nape of the neck, and the heads brought forward on either side, over the cheeks and compresses, to the middle of the upper lip ; the two heads cross at this point, drawing forward the cheeks, are again returned to the nape of the neck, where they cross once more, and are then carried forward to the forehead, and terminate by horizontal turns round the head. This bandage is liable to the inconvenience of pressing upon the pins, and retarding the process of cure, a disadvantage avoided in

Fig. 138.



that represented Fig. 138. suggested for the purpose by Mr. Dent of Dublin. It is made by dividing an inch-wide band into three portions, two of them a couple of yards long, the third about four inches; the latter is connected to the former by two sets of very narrow ribband, or silk threads, (*a a*) intersecting each other in such a manner as to give the intermediate portion the form of a noose (*b*); when applied, (Fig. 139,) the noose is slipped over the head, compresses placed upon the cheeks, and the threads drawn close upon the suture, allowing the ends of the pins to escape between them; the long bands, rolled up into two heads, are then carried back to the nape of the neck, where they cross, and terminate by encircling the head. A night-cap and four-tailed bandage to the chin (Fig. 149) will render the whole secure. A bandage resembling this in some points is figured in Mr. Thillaye's work: it is, however, less easily applied, and does not fulfil the object (viz. drawing forward the cheeks) more successfully.

Fig. 139.



A bandage is sometimes required, in aid of other means, for uniting transverse wounds of the throat. Fig. 140 is employed with this view (*fléchisseur de la tête*, Fr.) The head being covered with a night-cap, a couple of bands, about four feet in length (*a a*), are thrown over it, so as to cross each other upon the crown, and hang down in front of the chest and behind the neck; a circular bandage is passed round the head, and the posterior ends of each band interwoven with its horizontal turns, to fix them securely at the occiput; the anterior extremities (*b b*) of the bands are then drawn downwards, till the chin is brought to the position most favourable for keeping the divided parts in contact, and encompassed by the turns of a double-headed roller round the chest. Fig. 141 is the same bandage as constructed by M. Mayor, with the *triangle* and *cravate*. By this bandage the separated portions of the trachea, in deep wounds of the throat, may be maintained in apposition, when it is very difficult to succeed by other means. With the two pendant extremities reversed, and secured to the body bandage behind, instead of in front, it is employed under the name of *divisif du cou*, to prevent the contraction which follows cicatrization of burns of the neck and throat.

Fig. 140.

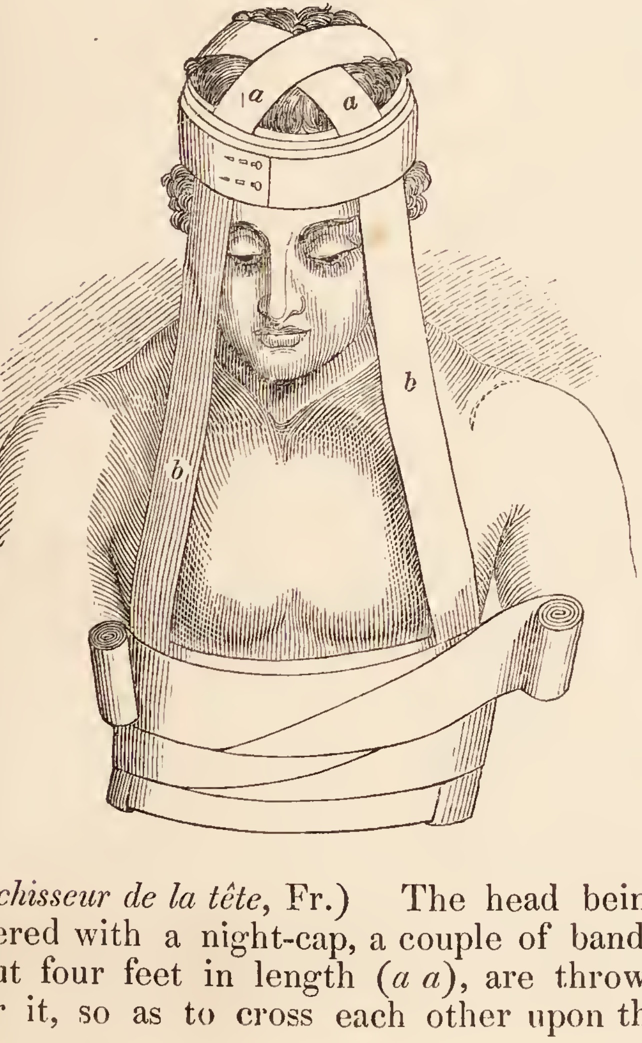
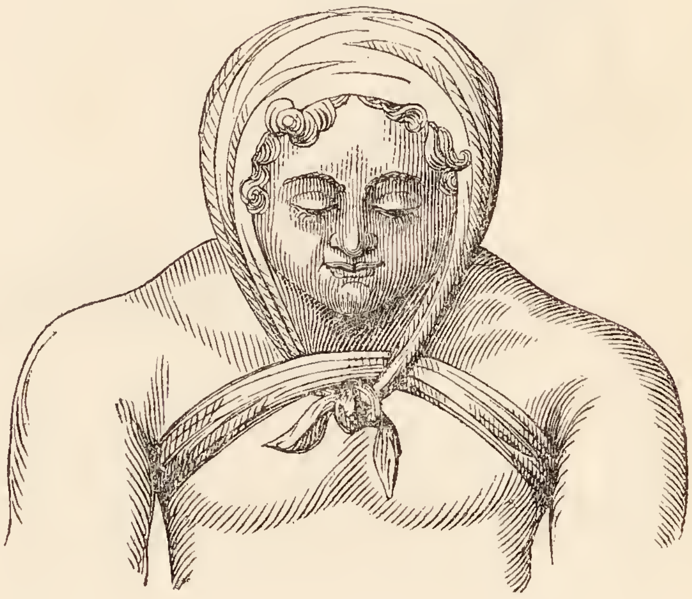


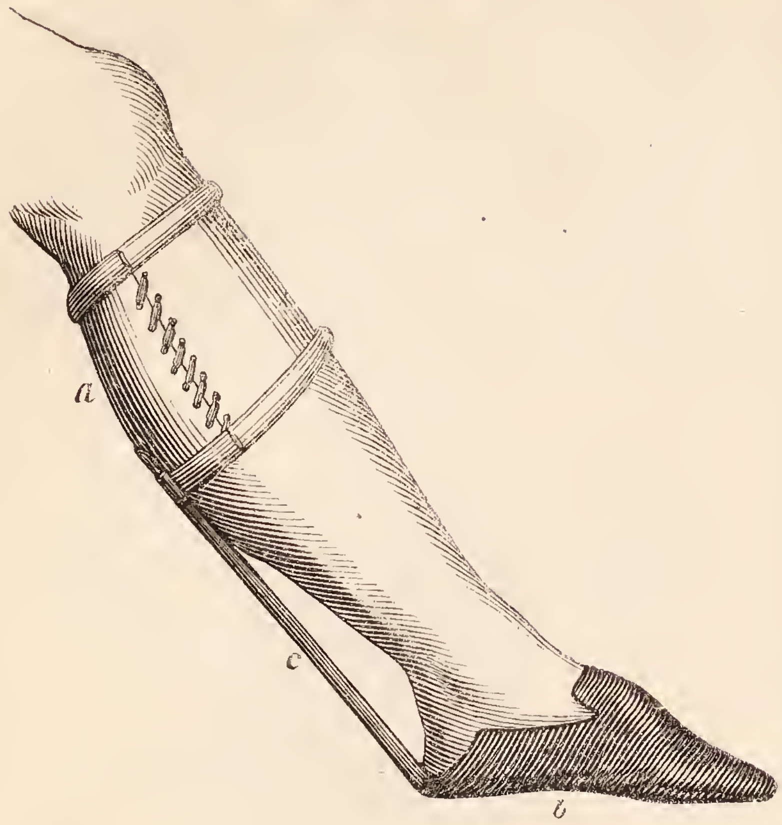
Fig. 141.



In deep transverse wounds of the limbs, position will do much to counteract the retraction of divided muscles, and when aided by the gentle compression of a spiral or tailed bandage upon the ends of the adhesive straps, applied to bring the edges together, will generally be found sufficient.

In certain divisions of structure, in which some force is required to overcome the action of the muscles, uniting bandages are of great service. Rupture of the tendo achillis, of the ligamentous attachment of the extensor muscles to the patella, &c., and fracture of the patella and olecranon, are of this description, (see articles on those subjects). Fig. 142. is the bandage employed in rupture of the tendo achillis. The separated portions of the tendon being brought together by complete extension of the foot, and flexion of the knee, a belt of leather or webbing (*a*) is buckled or laced, round the upper part of the calf; a soft compress about three inches long, is then placed on either side of the tendon, and confined by the turns of a spiral roller, lightly applied from the foot to the knee; a sock or slipper (*b*), having a strap (*c*) attached to the heel, is next put on the foot, and the strap

Fig. 142.

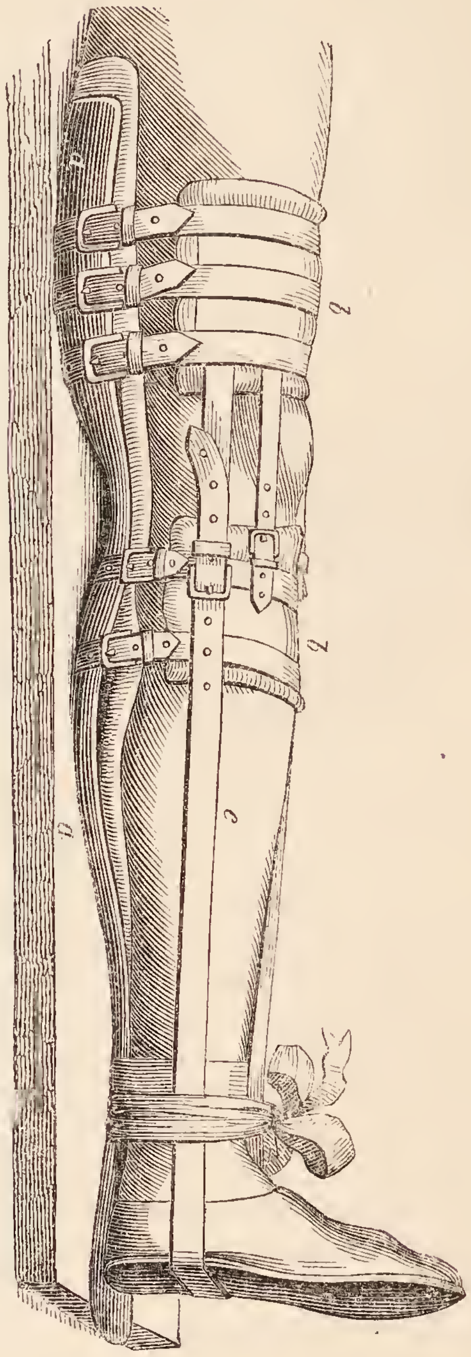


brought up to the back part of the belt round the calf to meet a buckle which secures it. The foot is thus maintained in the extended position, at the same time that the muscles of the calf are compressed, and all motion tending to separate the two portions of the tendon checked. A high-heeled shoe may be worn over the slipper, and the patient may sit up with the foot resting on a low stool.

In rupture of the ligament of the patella, or tendinous attachment of the triceps to the olecranon, the same means are requisite, as in the treatment of fractures of the patella and olecranon. Fig. 143 is the uniting bandage for transverse fractures of the patella, devised by Mr. Amesbury. The leg is first extended upon a long straight padded splint (*a a*), reaching from the middle of the thigh to the heel. Two portions of leather (*b b*), softly padded on the inner surface, and long enough to pass half way round the limb, are buckled firmly above and below the patella, by straps passing under the splint. Two short straps attached to the lower margin of the upper belt are brought down on either side of the patella, and buckled to the opposite margin of the lower belt, tightly enough to approximate the opposite edges of the pads, and at the same time the two portions of the patella. A long strap (*c*) is then carried down the outside of the leg, from the upper pad, under the sole of the foot, and up again on the inside, to meet a buckle on the lower border of the same pad. A handkerchief, or strip of roller, is finally tied round the ankle, to keep the long strap and splint in place.

The bandage recommended by Sir A. Cooper for these cases is simply a broad strap buckled round the thigh, just above the knee, from which a long strap descends, passes under the sole of the foot, and is brought up to a buckle on the opposite side of the thigh belt. The limb must be enveloped in a spiral bandage, and fixed in the extended position by means of the long straight splint, as seen (Fig. 143).

Fig. 143.



Mr. Amesbury's bandage for fracture of the olecranon, differs from that applied to the lower extremity (Fig. 143), merely by the omission of the long strap; the application and action of the two bandages correspond in all other particulars, and the arm is extended by a straight splint along its inner surface.

The term *divisive bandage* is applied to any bandage employed to counteract the adhesion or contraction of parts adjoining each other, during the cicatrization of burns, or of wounds attended with much loss of substance. The *divisif du cou*, mentioned above, is an example of this kind of bandage: complete extension or separation of the parts undergoing the process of cicatrization is the indication to be fulfilled by divisive bandages; and the situations in which they are usually had recourse to, are the front of the neck, the bends of joints, and the commissures of the fingers and toes.

Compressing bandages.—Compressing bandages are useful in a great variety of surgical maladies. They are applied with compresses to suppress hæmorrhage from wounded blood-vessels, to expel pus and certain secretions from sinuses and cavities where they might accumulate injuriously, to forward the cure of erectile and other tumours, &c. (for the utility of compression in surgical therapeutics, see that article); also to give support in cases where some pressure is requisite.

The spiral with reverses and many-tailed bandages (Figs. 130 and 132), are of general utility as compressing bandages. In employing the former for this purpose, it is necessary to watch its effects carefully, and remove it if much swelling should come on, as gangrene may result from long continued unequal compression. When a high degree of compression is attempted, the fingers and toes should first be encircled by narrow rollers. And if lotions are required whilst a bandage is applied to a limb, the rollers should be soaked in them previously, as moisture causes the stuff to contract, and without this precaution, a greater constriction might be produced than was intended.

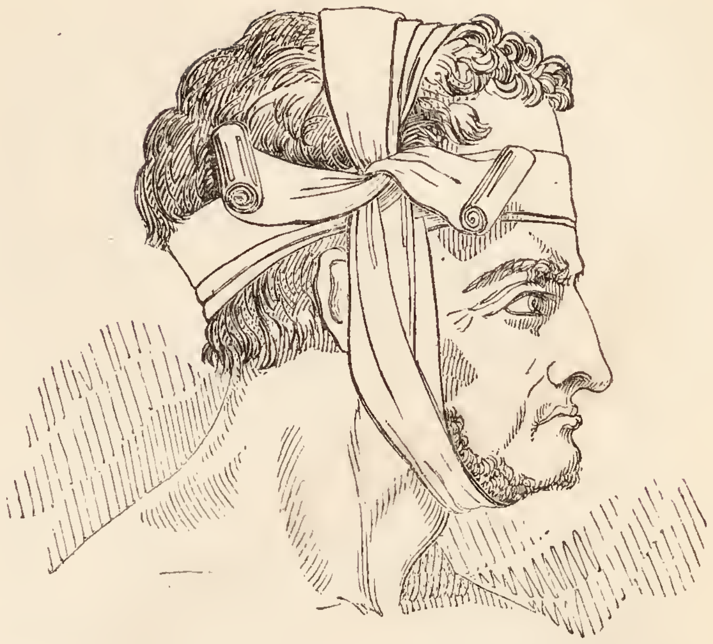
The prolonged application of a bandage, pressing equally upon a part, so as not to impede the circulation materially, will cause a dry scurfy state of the skin, and diminish the bulk of a limb considerably; a circumstance of which advantage has been taken in the army, to obtain an exemption from military duty. The employment of a bandage round a joint, also, too long persevered in, may produce a stiffness not easily overcome.

A circular bandage made with a double-headed roller, answers well as a compressing bandage for the head and trunk; it is seen applied to the chest (Fig. 140).

The middle of the roller being placed on the surface opposite to the seat of injury, the heads are carried round in contrary directions; at the points where they meet, however, an inconvenient roping of the bandage will occur, unless provided against by the following manœuvre, a kind of reverse; as they cross, let the undermost roller take an oblique direction downwards, continuing the superficial roller onwards; then by a turn over the latter, the first is made to resume its horizontal course evenly. This bandage may be applied with any degree of tightness, and the reverses give it great solidity. It is used to restrain hæmorrhage from wounded arterial branches in those parts of the scalp within its range, to restrict the movement of the chest in fracture of the ribs, and for other general purposes of compression over the head and trunk.

Compressing bandages for particular purposes.—The nodose or radiated bandage for the head (*stella, fascia nodosa,* of the older writers; *nœud d'emballeur* of the French), Fig. 144, is employed to suppress hæmorrhage from the trunk of the temporal artery. The vessel having been completely divided, and a compress placed upon the orifice, a double-headed roller is passed several times rather tightly round the head; the two heads of the roller are then crossed over the temple, so as to form a knot upon the compress; one is brought under the chin, the other over the crown, and on meeting at the wounded temple they are crossed again to form a second knot; this may be repeated three or four times if necessary, and the remainder of the roller afterwards carried round the head, to act pretty firmly on the knots and compress.

Fig. 144.



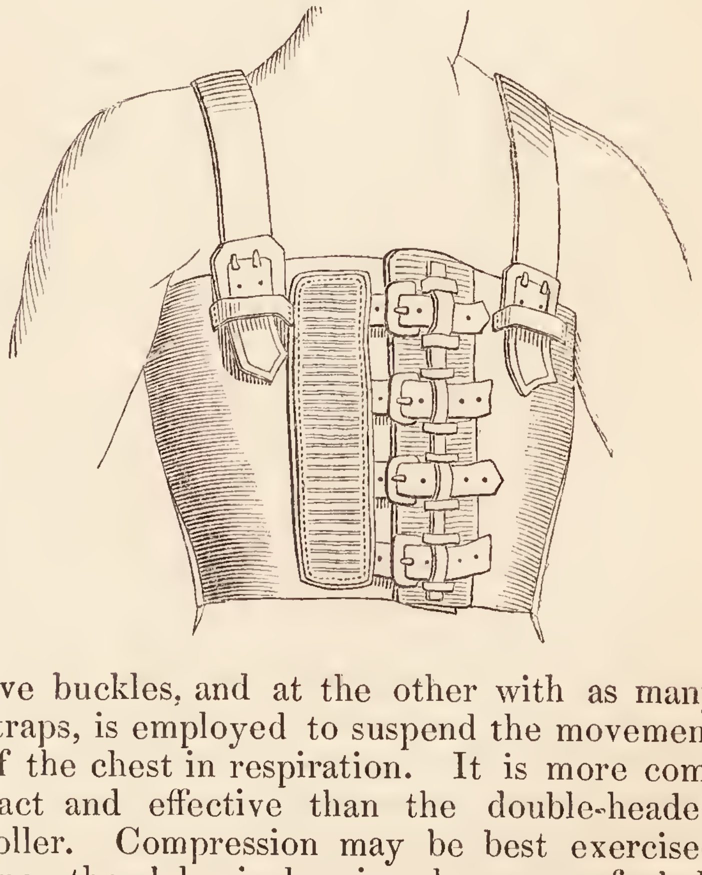
The reflex bandage for the head (*capelina* of Hippocrates, *capeline de la tête* of the French) was formerly a subsidiary remedy in hydrocephalus. It is retained in several modern works as a compressing bandage to the head, but owes its celebrity more to the elegance of its appearance than its utility. It does not deserve the trouble of description or application.

Compression may be exerted in the cavity of the axilla, by the figure of 8 bandage, *spica axillæ*, and a compress.

The compress being placed over the bleeding vessel, or the sinus, a single-headed roller is carried beneath the axilla, and round the neck, in the form of a figure of 8.

In fracture of the ribs, besides the circular bandage described above, a belt of webbing (Fig. 145) furnished at one end with four or five buckles, and at the other with as many straps, is employed to suspend the movement of the chest in respiration. It is more compact and effective than the double-headed roller. Compression may be best exercised upon the abdominal regions by means of a belt partly composed of elastic gum webbing.

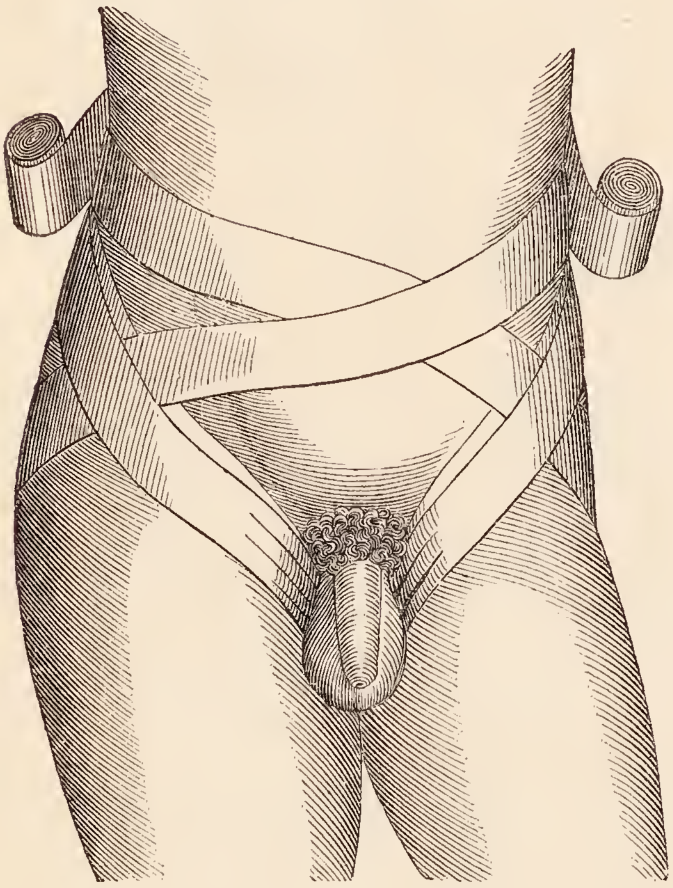
Fig. 145.



The spica bandage for the groin (*spica inguinis*, Lat.; *spica de l'aine*, Fr.) is used as a compressing bandage to forward the absorption of matter in an indolent bubo, or other glandular swellings, and as a temporary substitute for a truss to retain a reduced hernial protrusion, &c.

The spica for one groin consists of the turns of a single-headed roller, in the form of a figure of 8; in that for both groins, the double headed roller is used, and a figure of 8 described round each groin. Fig. 146, the double spica bandage, will sufficiently explain the composition of both varieties.

Fig. 146.

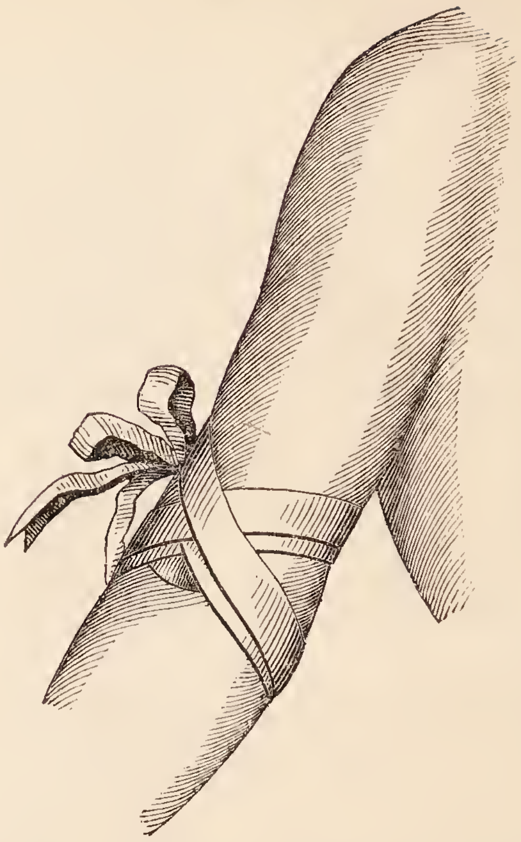


Of the bandages required in venesection little need be said. In applying the fillet above the elbow, preparatory to the puncture of the vein, it should be drawn tight enough to obstruct the flow of the blood upwards, without interrupting the arterial circulation. In the figure of 8 bandage after bleeding, (Fig. 147) the obstruction ought to take place below the puncture, and with this view it is better, after completing the figure of 8, to bring the ends of the fillet round the forearm, and tie them in front.

After bleeding in the foot, a figure of 8 bandage round the ankle and instep is necessary.

As *supporting* bandages, owing their value to the moderate compression exercised by them, Churton's Stocking bandage (see p. 457) and the several contrivances into which the elastic gum webbing enters, must not be omitted. This material is worked up into gaiters, stockings, knee-caps, and belts for the abdomen and other parts, with very beneficial effects: as specimens may be seen at all instrument-makers, they do not require further mention.

Fig. 147.

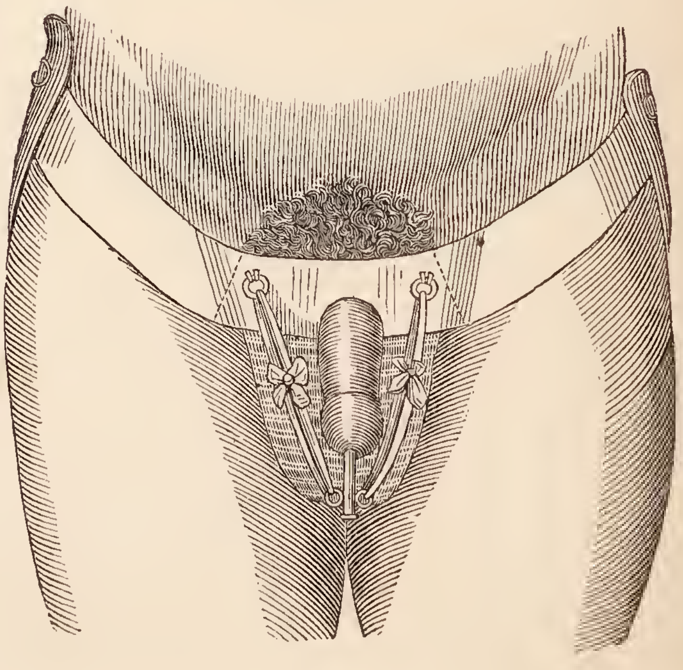


Retentive bandages.—Retentive bandages serve to retain parts that have been displaced from their proper situation. Under this head are comprised trusses and other instruments, designed for the relief of hernial protrusions, certain apparatus for fractures, and the bandage required as a safeguard after the reduction of a dislocation, &c. (See Hernia, Fracture, Luxation.)

The use of the spica and T bandages, as temporary substitutes for more complete apparatus to retain hernia and prolapsus when reduced, has already been alluded to. A very complete bandage for prolapsus ani is the brace of Weiss, the two bands of which are elastic, and cross beneath the anus, which rests upon a compress of soft sponge, or a boss of smooth ivory.

The suspensory scrotal bandage intended for the support of a swelled testicle, a hydrocele, or a large scrotal rupture, was converted by Mr. Hunter into an apparatus for retaining a catheter in the bladder, as represented Fig. 148. Two or three narrow tapes, stitched

Fig. 148.



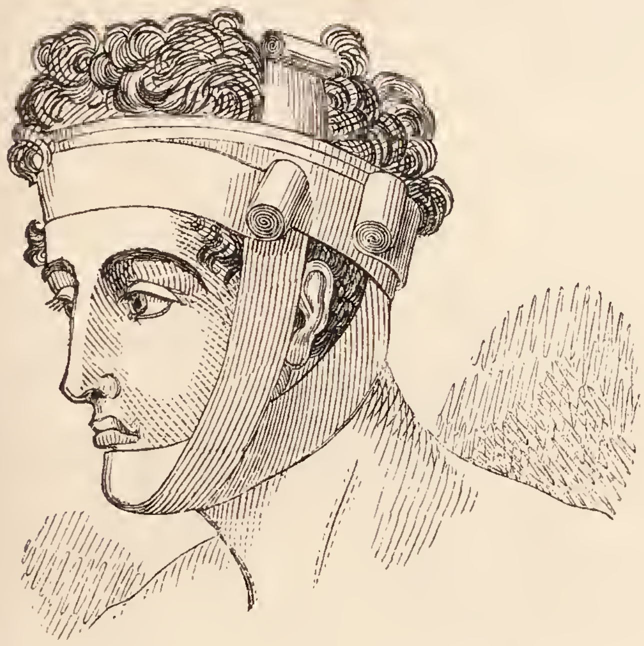
to the edges of the opening for the penis, and tied to the rings at the mouth of the catheter, will answer as well as the rings seen in the engraving.

Another contrivance for the same purpose consists of a wooden ring, large enough to embrace the penis, which is confined upon the pubis by four tapes, passing up before and behind the pelvis to a waist-band; three narrower tapes, attached to the ring, are brought forward and tied to the mouth of the catheter. The French have invented a somewhat similar apparatus, made of elastic gum, in order that the varying diameters of the penis may be accommodated. Weiss's bracelet for retaining the catheter is ingeniously contrived to answer the same purpose. For retaining the catheter in the female urethra, a T bandage will suffice.

Of apparatus for retaining fractured bones in their natural situation, one or two varieties only belong to the present subject.

In fractures of the lower jaw, that bone is supported, and the splint and compress confined to it, by means of the four-tailed bandage (*fronde à quatre chefs*) already mentioned under the head of confining bandages. It is seen applied for this intention, Fig. 149. The rest of the apparatus being properly adjusted (see Fracture of the jaw), the middle of the sling is placed upon the chin, and the two heads from the front of the jaw carried backwards to the nape, where they cross, and are afterwards brought round the head; the two heads from beneath the jaw are drawn up on either side to the crown, crossed, and again passed under the jaw to give the requisite support; at the points of intersection a few stitches are necessary to retain the bandage in place.

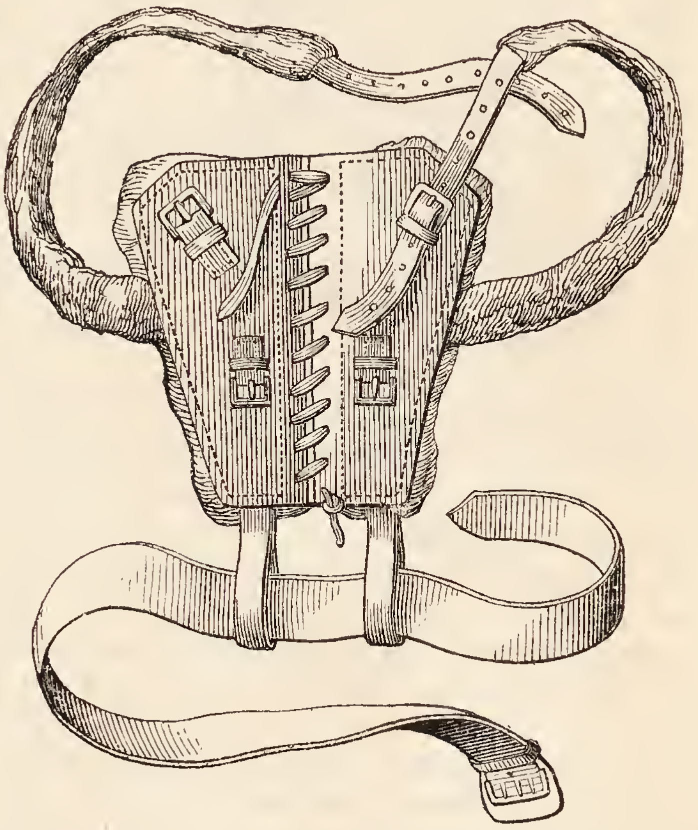
Fig. 149.



For fracture of the neck and condyles of the jaw, a bandage differing a little from the above is described by the older writers, under the name of *capistrum*, by the French as *le chevestre*. The four-tailed bandage will answer quite as well, if the support is made to act directly upon the angles of the jaw. This bandage is also necessary after the reduction of a dislocation of the jaw.

A fractured clavicle is also treated by bandage. A double figure of 8 bandage to draw back the shoulders, the arm being supported in a sling, was the practice formerly adopted in these cases; but the rollers are apt to become roped and excoriate the edges of the axilla, and Brasdor suggested the bandage which bears his name as an improvement. Fig. 150. is Brasdor's bandage, consisting of a back-piece of stout leather softly cushioned, with two well padded straps attached to the sides, and a belt, running along its lower margin, to surround the waist and fix it in its proper situation. One of the straps is passed under each axilla, and returns over the shoulder to be buckled to the upper part of the back-piece. The back-piece is usually divided down the middle, and the two portions connected by a lace in order that it may fit persons of various sizes.

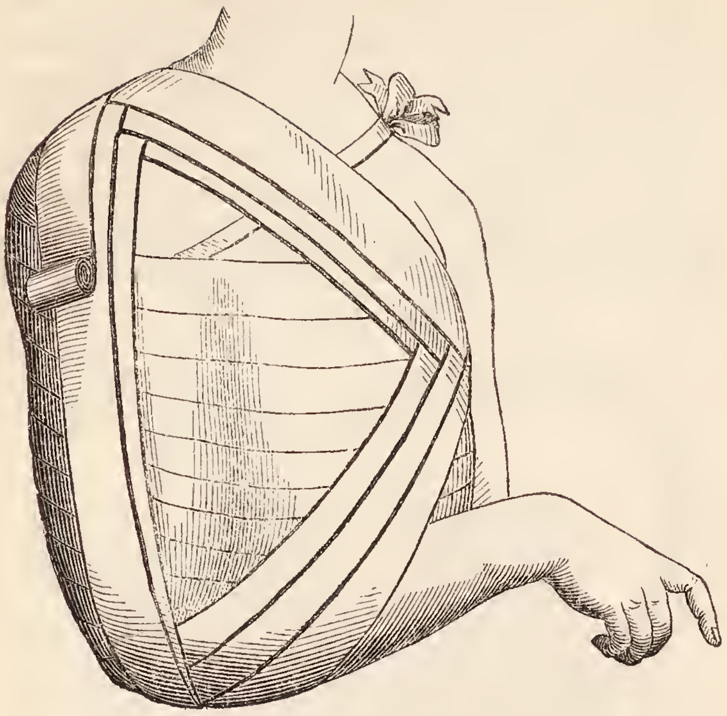
Fig. 150.



Drawing back the shoulders alone, however, is not the principle upon which fracture of the clavicle should be treated (see art. Fracture); the indications which every form of bandage should fulfil are three, to elevate the shoulder of the injured side, carry it out from the body, and throw it back, to produce extension of the clavicle and bring its overlapping ends in contact.

These were the views advanced by Desault, and upon these principles his bandage, Fig. 151, is constructed. Two single-headed rollers, nine yards in length, and a wedge-shaped pad for the axilla, are required for its formation. The pad is placed in the arm-pit and secured by two ribands attached to it, which are tied over the opposite shoulder; the elbow is brought forward, lifted upward, and pressed inward against the chest, thus making the humerus act as a lever upon the pad in the axilla, to extend the fractured clavicle; being supported in this position, with the elbow bent, one of the rollers is carried round the chest and upper arm, drawing it more tightly as it approaches the elbow; a compress, dipped in

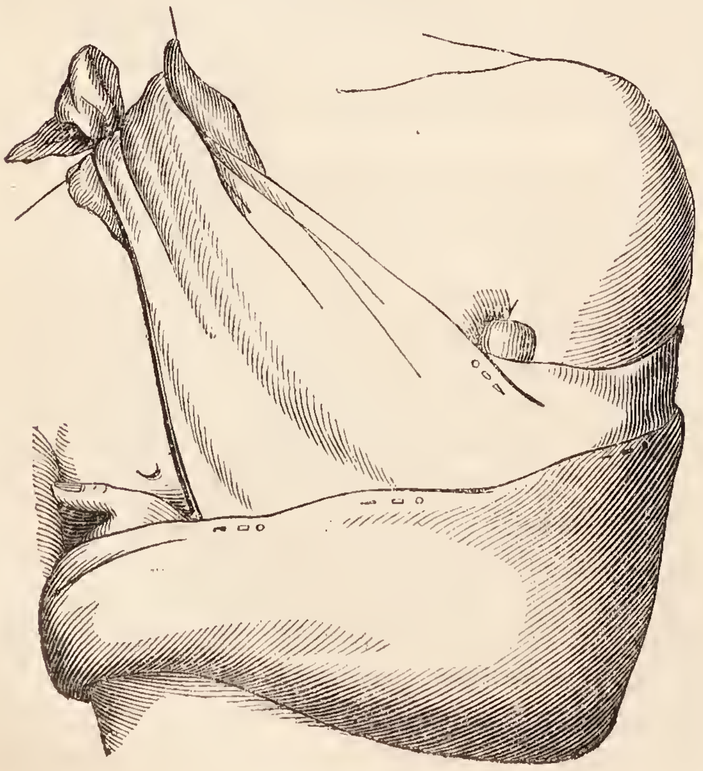
Fig. 151.



camphorated spirit, is next laid upon the fractured bone, and the second roller taken up; commencing in the opposite axilla, it is carried across the breast, over the compress and shoulder, and passing down, behind the arm and under the elbow, again mounts upon the breast; its course is then continued under the sound shoulder, across the back, a second time over the compress and fractured clavicle, and down in front of the arm to the elbow, whence it ascends obliquely across the back to the axilla, where it commenced, and the same course is repeated till the roller terminates, The turns are secured by pins or stitches and the hand supported by a sling.

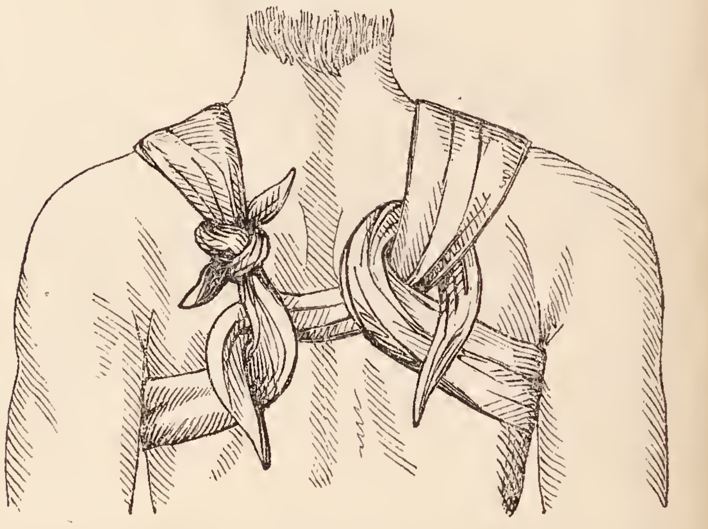
It is, however, very difficult to keep the folds in place, and many attempts have been made to provide a bandage upon the same principle, more compact in its structure, and less complex in its application. Boyer in France, and Mr. Earle in this country, have contrived ingenious forms of apparatus with this view; but the most compact, and at the same time most simple bandage for this purpose is that represented at Fig. 152, in the construction of which a cushion for the axilla and two handkerchiefs are all that is required; the cushion being inserted beneath the axilla, the arm is suspended in a sling, differing slightly from the common form. The handkerchief is reversed, so that the corners support the hand, and the doubled edge envelopes the elbow, whence the posterior long extremity is carried up behind the back, to meet the anterior ascending in front, and be tied over the opposite shoulder. This is by no means a needless distinction; the action of the common form of sling is to support the hand and fore-arm, that of the one just described to elevate the elbow and shoulder, which it does most effectually; where it rests upon the shoulder a soft pad must be interposed; the fore-arm and elbow are further included in another doubled handkerchief, the ends of which are carried round the waist to confine the elbow closely to the side. If the outer handkerchief be well attached to the sling by pins or stitches, the bandage may remain undisturbed until the fracture is consolidated, merely tightening the sling and waist-band occasionally.

Fig. 152.



In comminuted fracture of the clavicle, or in any case where more than ordinary difficulty in maintaining the bone in its proper position occurs, Brasdor's bandage (Fig. 150), or M. Mayor's substitute for it (Fig. 153), made with two handkerchiefs folded as *cravates*, may be readily combined with the above, and additional power be thus obtained.

Fig. 153.



This bandage is also used in fractures of the neck of the scapula, and of the acromion, omitting the pad for the axilla in the latter case. Dislocations of the clavicle too are treated by it.

In that very troublesome accident, displacement of the acromial end of the clavicle, an additional broad band is necessary, passing under the elbow, and over the shoulder of the injured side, and tied or buckled tight enough to preclude the possibility of motion between the end of the clavicle and the acromion; where it crosses the shoulder, a soft cushion should be placed beneath it.

Fracture of the body of the scapula is managed by applying compresses in such a manner as to keep the fractured surfaces in contact, and confining them by a circular bandage carried round the trunk and arm, at the same time supporting the fore-arm in a sling.

In fracture of the coracoid process, a compress must be placed beneath the broken process, and secured by a circular bandage, passing obliquely across the back and breast, and over the injured shoulder, so as to draw it forward and depress it a little. The fore-arm must also be supported by a sling.

Many other forms of bandage not described in the preceding pages, may be found in the works that treat of this branch of surgery; but the present article being rather a general survey of the subject, than a complete enumeration of every variety of bandage, a multiplication of means to fulfil the same end would be as much out of place here as they are in actual practice. Let a young surgeon once attain promptness and dexterity in the formation of those bandages constructed with rollers and handkerchiefs, and he will seldom feel at a loss in any case requiring such mechanical aid. But how to arrive at this practical intimacy is a question which deserves consideration. Whilst its importance is forced upon him daily, and a sedulous cultivation of it is urged both by writers and lecturers on surgery, the English student looks round him in vain for any ready means of acquiring it. Hospital practice, which can alone ensure the requisite degree of skill, can never be usefully distributed among all; but in the schools of the continent, a tolerable substitute is provided by the establishment of a public course of instruction, a person attending upon whom the bandages are applied. In default of this source of instruction, parties might assemble for the purpose of exercising upon each other. Both hospital and private practice may thus be commenced with a greater familiarity with this branch of a surgeon's duty, than the student often possesses after many months of dressing.

Although the introduction of the names of many obsolete bandages would have interfered too much with the practical character of this article, they will be found elsewhere alphabetically arranged, with a short description of the uses attributed to each of them in the older writers.

(Henry T. Chapman.)

BDELLOMETER, from βδέλλα, a leech; and μέτρον, measure. The name of an instrument employed to abstract blood by scarification and cupping. Its derivation indicates that the blood is obtained by suction, and that its quantity is at the same time measured.—(See Cupping.)

BELLADONNA, (*Atropa Belladonna* Lin.) *the deadly nightshade.* The narcotic powers of the deadly nightshade have led to its extensive employment both internally and externally as a remedial agent in the relief of pain. Within the last few years it has been found to exert a marked influence in subduing erysipelas. The property possessed by this plant, in common with the *datura stramonium* and the rest of the solanum tribe, of dilating the pupil, renders it a valuable auxiliary in ophthalmic surgery. And a supposed analogy between the action of the iris, and that of the sphincters and some other parts endowed with muscular contractility, has induced some practitioners to prescribe it with the view of mitigating spasmodic contractions of such structures.

The powder of the dried leaves was formerly administered internally, and infusions or decoctions were used as external applications. The extract or inspissated juice of the belladonna is now ordinarily employed. Its anodyne effects are manifested far more decidedly in its external application than when given internally; in the latter case it produces an intoxicating rather than a sedative effect; very small doses exciting the brain even to delirium.

In pain arising from gouty or rheumatic inflammation of the joints, inflammations of the skin, testicles, and urethra, from hæmorrhoids and cancerous affections, great alleviation may be obtained by fomenting the part with a decoction of the dried leaves, in the proportion of one ounce to two pints of water, as well as by the use of poultices made with this decoction. One or two drachms of the extract may be combined with a poultice as a substitute for the decoction. In chordée, friction along the course of the urethra with the undiluted extract is more convenient. It is likewise employed with advantage in tooth-ache and ear-ache.

In chronic inflammation of the uterus and in dysmenorrhœa, ease will frequently result from the use of injections of the decoction of belladonna, or of the diluted extract.

In neuralgia the extract of belladonna has been exhibited internally with success in doses of a quarter of a grain, repeated hourly till relief is obtained, taking care to discontinue it immediately symptoms of dizziness manifest themselves. When superficial nerves, as the supra-orbital and those ramifying in the scalp, are the seat of pain, its efficacy applied externally is universally recognized. From ten grains to two scruples of the extract diluted with a little water should be rubbed for ten minutes into the skin immediately over the seat of pain, renewing the application every two, three, or more hours, till the pain is subdued. Messrs. Chevalier[1], Will, and Dr. Henry relate numerous cases of tic douloureux in which this practice was more or less successful. In sciatica and similar affections of the more deeply seated nerves the cuticle must be removed by blistering before the belladonna can be brought to bear upon the nerve; but, as this mode of applying it requires caution and the contact of the extract with the denuded skin excites very acute pain, it must be diluted by rubbing down a given quantity, from two to eight grains, with some simple cerate, and permitting it to dissolve gradually.

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[1] Med. and Phys. Journ. 1826.

In erysipelas it was first recommended by Hahnemann on homæopathic principles, rubefaction of the skin sometimes following its internal administration. Mr. Liston speaks highly of its curative powers in this disease, in doses of $\frac{1}{8}$ gr., every four hours; and his experience of its efficacy has been confirmed by others[1].

The agency of belladonna in producing dilatation of the pupil has been taken advantage of in order to facilitate the operation for cataract, whether by depression or extraction. Also, to prevent union of the edges of the wound after division of the iris in the operation for artificial pupil. It is likewise resorted to, according to the recommendation of Himly, to enable the surgeon to satisfy himself of the non-existence of adhesion between the iris and capsule of the lens; and was employed by Mr. Saunders to prevent the occurrence of this adhesion with the edges of the torn capsule, after his operation for depression, by introducing the needle through the cornea. M. Berard believes that it has a further effect in obviating the inflammation of the iris, so frequently a consequence of depression. Dilatation of the pupil for these several purposes is readily accomplished by rubbing the extract over the eyebrow and lid, or by dropping a solution of it in water into the eye.

Finally, M. Lisfranc and others have found it of great service in allaying excessive sensibility of the eye in conjunctival inflammation.

Reasoning from its action upon the iris, Chaussier tried the effect of a pommade of belladonna (in the proportion of four drachms of the extract to one ounce of cerate) with the view of expediting dilatation of the os uteri in tardy labour. It has been resorted to on the same ground to allay spasm of the urethra by Dr. Holbrook, who recommends the infusion of the leaves as a lavement, as an injection into the urethra, and as a fomentation to the perineum; and by Will, Guerin of Bordeaux, and others, who introduced a bougie smeared with the extract into the urethra. Dr. Blackett employed it also with effect in spasmodic constrictions of the rectum; and reports favourable to its influence in promoting reduction of incarcerated hernia have been published by MM. Guerin and Carrée[2].

The supposed specific effects of belladonna in rabies have been shown by Mr. Youatt to be unfounded, although he admits its beneficial influence (on the dog) in many instances[3]. Its utility also in tetanus is extremely problematical. The value of belladonna as a prophylactic in scarlatina and as an antispasmodic in hooping-cough does not come within the scope of an article on its surgical uses.

(Henry T. Chapman.)

BINOCULUS, a bandage, formerly used to cover both eyes.—(See Bandage.)

BISTOURY (s. m. *scalpellus*), the name of an instrument in use amongst surgeons, in operations requiring a division of the soft textures of the body. The term bistouri, or bistoury, has been applied, according to Huet, from the circumstance of the town of Pistori having at one time been celebrated for the manufacture of this kind of instrument.

The bistoury has been used for almost every kind of cutting operation, and has been constructed in a variety of shapes and sizes to suit the fancy of the operator, or the peculiar nature of the operation.

Almost every one in the habit of using such instruments, has had them constructed according to some ideas of his own; and it would be an endless task to describe more than those which have been most generally approved of amongst practical surgeons.

A bistoury consists of two parts, a blade and handle; and the simplest form of the instrument is that in which the blade is firmly fixed and riveted in the handle. The blade is formed of finely-tempered steel, and the handle of some hard wood, such as ebony or ivory. The length of the instrument varies from six to eight inches; its breadth and thickness also vary; in some the handle is not larger than that of a common scalpel, the blade being about three inches long; in others, the handle is much stronger, and of greater length, whilst the blade may be of the ordinary size, or it may be larger or smaller. The breadth of the blade may vary from one-eighth of an inch to five-eighths; it may be straight or curved; and in the latter the cutting edge may be on the concave or convex margin. The point may be quite sharp, so as to penetrate the soft parts, on the application of a slight force, or it may be rounded-off like that of a probe; the former is termed the *sharp-pointed bistoury*, the latter the *probe-pointed*. The cutting margin may extend throughout the whole of the blade, or may be confined to a small portion.

The common bistoury, such as is used for making incisions, as in erysipelas, or in the removal of tumours, fingers, or toes, is about seven inches in length; the handle being about four, the blade about three. The latter is firmly fixed in the former, in a groove cut for its reception, and rivetted by two pins of brass, silver, or platina; brass wire is most frequently used, though either of the other metals ought to be preferred. Ebony-wood makes the best handle, as the blood is not so conspicuous upon it, nor is it so apt to slip in the fingers as ivory. Its breadth, where the blade is fixed, is about three-eighths of an inch, and its thickness two lines, getting somewhat thinner and narrower near the other end. In general the surface is quite smooth, though some prefer it rough, so that it may be more firmly held in the fingers of the operator. In the blade we distinguish a variety of parts, viz. the point, the back, the face, or cutting edge, the sides, and the heel. The point, which ought to be in a line with the long axis of the blade, is extremely sharp, so as readily to enter the soft parts; the back, at its thickest part, where the blade is free of the handle, is in thickness about the sixteenth part of an inch, gradually getting narrower as it nears the point: the face, or cutting edge, extends from the heel to the point; both the face and back are slightly convex, so as to meet at the point; the sides, about midway between the heel and the point, are about three-eighths of an inch in depth, gradually becoming narrower towards the point; they are a little concave in their transverse axis, and are highly polished; the heel is generally about half an inch in length, a little broader than the rest of the blade, and of the same thickness throughout. On one side of this part the name of the maker is commonly impressed.

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[1] See Lancet, January 1836, April 1836 and 1838.

[2] Journ. des Conn. Med. Chir. Mai 1835.

[3] See his paper from the Veterinarian, published in the Lancet for Sept. 29, 1838.

Most of the bistouries in use are modifications of that now described; and as some of these are highly useful in surgical practice, it is necessary to notice them in this place.

A knife, larger and stronger in all points, is often used in the removal of very large tumours, and in partial amputations of the foot. Some surgeons for many operations, prefer the blade a little longer, narrower, and thinner in the back; indeed, it is altogether so slender, that the term used by the French, *le bistouri aiguillé*, is not unaptly applied. The handle is of the ordinary shape and form. A bistoury of this sort is decidedly superior to that with the broad blade in many cases where it is necessary to employ the knife. In amputations of fingers and toes at the articulations, the narrow blade passes with greater facility through the joints; and from this circumstance ought always to be used in such operations. The extent of cutting-edge in a bistoury, gives it, in these cases, a superiority over the ordinary dissecting scalpel. In the operation for hare-lip, and in opening abscesses, whether superficial or deep-seated, no instrument answers better; and in all instances, where there is a doubt as to the presence of matter, more particularly if it be deep-seated, or the nature of a tumour, when a puncture is deemed necessary, it is the best that can be used. This instrument is one of the most useful in surgery. At one time, when surgeons were not so dexterous in the use of the bistoury as they are in the present day, this was considered a dangerous weapon in the hand of the operator; but almost any cutting operation may be done by one familiar with its use. I have seen the eyeball extirpated with one of the kind; and have even, with a similar instrument, opened the median basilic vein, lying directly over the humeral artery at the elbow. I by no means, however, recommend its use in this latter instance as a substitute for the lancet.

This narrow blade is often made with a slight curve, and the cutting edge on the concave margin, and is used in many instances in preference to the straight blade; it is generally used in laying open sinuses, and in operating for phymosis. A director is first passed under the part to be cut, and the knife is run along in the groove; the surgeon may then either cut from himself, or what may be better, particularly in phymosis, raise the point through the soft parts, and draw the knife towards him. In this way the prepuce, or the soft parts over a sinus, can be readily cut. If there be any dread of the point touching the soft parts, when this is not desired, it may be covered with a little bees'-wax, which will break off when the force is applied to push it through the textures.

In some bistouries the heel is much longer than usual, and the cutting edge of less extent. Such an one was recommended by Béclard for lithotomy; a modification of which is at present used by Mr. Liston for the same operation. In this operation a small extent of cutting edge only is necessary, and the blunt heel prevents injury to the rectum. These are the *sharp-pointed bistouries* most worthy of notice; and we shall now refer to the *probe-pointed*, which are also much used by surgeons.

The *probe-pointed bistoury*, in the form generally used, has a handle the size of a common scalpel, and a blade about three inches in length, very narrow and slender, and slightly curved. The cutting edge is on the concavity; it is sharp from the heel to the point, where it terminates abruptly at right angles to the blade. The back at the point is rounded off with a button-like head, which prevents injury as the instrument is passed under, or near textures, which it is desirable to avoid. This kind of bistoury is more generally used in laying open sinuses than that with the sharp point. In the operation for *fistula in ano* it is the only one used, as also in the removal of portions of the tonsils, and of the uterus. In the operation for hernia it is nearly indispensable; after the integuments have been incised, the different coverings of the sac, as well as the stricture, are cut with this knife. This form of bistoury was recommended particularly by Mr. Pott, and bears his name to the present day. In cutting the stricture in hernia, more particularly the crural hernia, Sir Astley Cooper used a knife of the same size and form, but having an extent of cutting edge of only eight lines in length. The advantage of this knife is considerable, as there is little risk of wounding any part of the intestine which may overlap the fingers whilst the knife is lying upon it. An improvement has been made on this form of the instrument, by applying a small rod and sliding sheath over the edge, by which its extent of cutting surface can be made to vary from eight lines to one. Were the edge of the knife, in cutting Gimbernat's ligament, always made of the latter extent, there could be little or no chance of wounding the obturator artery, however close it might be to the part requiring to be cut. Instead of having the edge on the concave side, Dupuytren, for the same operation, used a knife with a small extent of cutting edge on the convex side. The advantage of this kind is, that only a small part of the edge is applied at one time. A straight narrow-bladed bistoury, with a probe point, is sometimes used, but it possesses no peculiar advantage.

All the instruments above described, are often, for the sake of convenience, made so that the blade fits into the handle in the manner of a pocket-knife. At the junction of the blade with the handle, the mechanism is such, that when the blade is fully opened, it cannot readily be shut again, without raising a small catch which keeps it firmly fixed. This is an improvement on those made some years ago, which, when the finger was applied to the back of the blade, were apt to shut when not intended. The handle is made of two slips of ivory, or tortoiseshell, which are laid upon two thin plates of iron or brass, between which a spring is contained, and the blade kept steady, as in a pocket-knife. On the back of that part of the blade which is between the leaves of the handle, a small square notch is cut, into which a corresponding projection on the under surface of the spring passes, when the blade is fully extended. By this mechanism, until the spring is a little raised by the thumb-nail, it is not easy to close the blade. Sometimes, instead of the blade being pinned into the handle, the two are so constructed that they can be separated with ease at will, though there is no chance of this occurring by accident during an operation. In this way one handle may answer for a variety of blades. The chief advantage of these *clasp bistouries*, as they are technically called, is that they can be readily put into a small case, or worn in the pocket like a common penknife. Though originally constructed in France, some of our British cutlers seem to excel in the fabrication of these instruments. I have seen none better in make or material than those constructed by M'Cleod of Edinburgh.

The most celebrated, perhaps, of all these instruments, is that which was used by Frère Côme in the operation of lithotomy, the *bistoire*, or *lithotome caché*, devised by him after the model of a knife used by Bienaise in the operation for hernia. In Côme's instrument, the blade, which is sharp-pointed, and curved, is entirely concealed in a sheath, from which it can be partially raised at will. Near the handle the blade is fixed in the sheath by a steel pin, which allows a hinge-like motion; behind this pin there is a rod extending in the direction of the handle, and separated about an inch from it at its extremity; this rod is connected with the blade; and when it is pressed towards the handle, the blade is raised from its sheath; in this state the distance between these two is greatest at their points. The instrument is so constructed that the distance can be increased or diminished at the will of the surgeon. About fifteen lines is the greatest stretch. By means of a spring between the handle and the rod, the blade is always confined in the sheath, until pressure is applied upon the rod, which then acts as a lever in raising the blade. This instrument is now seldom used in lithotomy, though it was often, and, by many considered the best for cutting the side of the prostate. After an opening of the usual size, and in the usual situation, was made in the perineum with a scalpel, the point of the *bistoire caché* was passed through a small opening in the membranous portion of the urethra, along the groove of the staff into the bladder; it was then opened to the extent the operator desired, and the left side of the prostate, and neck of the bladder, were cut in withdrawing the instrument. A more complicated form of the *bistoire caché* has been recommended by Dupuytren, in which there are two blades, one on each side of the sheath, each being placed, when opened, at such an angle as, whilst withdrawing them from the bladder, to cut each lateral lobe of the prostate in a direction downwards and outwards. The operation, thus done, has been named the *bilateral*. The instrument is most ingeniously constructed, but does not seem to be much in use among lithotomists. Since the death of Dupuytren, a memoir by this distinguished surgeon has been published by Sanson and Begin, for the purpose of explaining the nature of the operation with this instrument. The incisions into the membranous portion of the urethra were made by Dupuytren with a short double-edged bistoury, similar in shape, though somewhat smaller in size to the poniard-shaped knife, so celebrated in the history of Frère Jaques' operation.

Many years ago, Mr. Thomas Blizard recommended a bistoury for lithotomy, which has been a good deal used in this country. The blade is long and narrow, being fixed in a strong handle, and beaked at the point like a gorget. After an opening is made in the perineum, and membranous portion of the urethra, the beak of this knife is run along the staff into the bladder, and the necessary incision made in the prostate and bladder. When a beaked knife is preferred for this part of the operation, there is none better for the purpose than this one.

Many surgeons of the present day prefer the bistoury to the common scalpel in almost all operations where the latter is in general employed. The length of the blade, in many instances, gives it a decided advantage over the scalpel; but in all cases where much accuracy and steadiness is required, such as in cutting for arteries, this knife (the scalpel) should be used. In order to handle the bistoury with dexterity a deal of practice on the dead body is necessary; and all students should practice dissections and operations with it before using it on the living body. In some modern works on operative surgery, particular instructions are laid down as to the different positions in which it ought to be held during different operations. It is, perhaps, right not to omit these in a systematic work of this kind; but the young surgeon ought always to bear in mind, that without previous practice in using the instrument on the dead subject, these will be of little service in giving him the requisite tact and dexterity in operations on the living body. (See INCISION.)

(*Wm. Fergusson.*)

BLADDER (κύστις, Gr. *vesica*, Lat.; *vessie*, Fr.) The urinary bladder is a muscular membranous bag, of a round, elongated shape, situated in the cavity of the pelvis, behind the symphysis of the pubis, and in front of the rectum, in the male, and of the vagina, in the female, and serving as a temporary reservoir for the urine, which it has the power of expelling at variable intervals, through the urethra. The bladder is liable to a great number of affections, most of which fall within the scope of surgery, and may be enumerated as follows :—defects of conformation, inflammation, wounds, rupture, hernia, cancer, fungus, varicose enlargement of veins, retention and incontinence of urine, foreign bodies, and fistula. In this place we shall confine ourselves to the consideration of its anatomical structure, and the defects of conformation which it occasionally presents.

The several portions of the bladder are described as the body, and the superior and inferior fundus ; the latter terminates in the neck, or cervix, the former in the urachus. The walls of the bladder are composed of three layers, the muscular, the vascular, and the membranous ; to these a fourth may be added, the peritoneal ; as the bladder, although external to the peritoneum is covered at its superior fundus, and over a portion of its posterior wall, by this membrane, as by a cloak. Throughout the rest of its extent, it is connected to the surrounding parts by cellular tissue of so loose a texture, as greatly to facilitate the changes which the viscus undergoes in passing from vacuity to plenitude, and *vice versâ*.

The muscular layer, or coat, consists of muscular fibres arranged in a great variety of forms, some running longitudinally, others transversely or obliquely, and interlacing and crossing each other at intervals. At the inferior fundus these fibres form the sphincter of the bladder, and they are seen to take the direction of the two orifices of the ureters, thus bounding a space to which Lieutaud gave the name of *trigone*.

The vascular layer is very thin, and lies between the muscular and the membranous ; the latter is smooth, unless when rendered uneven by the volume and irregularity of the muscular columns.

Defects of Conformation.—The bladder may be entirely wanting. Benninger relates, that in opening the body of Abraham Clef, he could not find a bladder, and that the sound introduced into the urethra passed directly into either ureter. On laying them open, no intermediate cavity could be discovered. Richardson relates the case of a Yorkshire boy, aged 17, who had never voided his urine by the urethra ; the ureters opened into the rectum. The urine thus passing by the anus gave rise to constant diarrhœa, which did not, however, impair the health. The ureters have also been known to open into the vagina in the female.

All these malformations, however, are comparatively rare. Another, which is met with from time to time, but more frequently in the male, and which is known under the name of *extrophy*, or *extraversion* of the bladder consists in the deficiency of the anterior wall of this viscus ; in these cases, the symphysis of the pubis, is not closed, and just above it a portion of the abdominal walls in front of the bladder is wanting, and in its place the posterior wall of the bladder is thrust out by the weight of the intestines. The mucous membrane of the bladder, which is thus exposed, presents itself as a tumour of a deep red colour. At its inferior part two small nipples, the orifices of the ureters are seen, from which the urine oozes or flows constantly. The navel is exceedingly small. The external parts of generation are also, more or less, malformed ; in the male, the penis is short, a slit representing a rudimentary urethra ; in the female, the urethra opens above the clitoris, or remains closed by a fold of membrane. This malformation cannot be remedied by the resources of art ; and as the subject advances in life, the urine being continually poured out on the surrounding skin, produces scalding, excoriation and erysipelatous pustules, which cause great annoyance ; the clothes too, become saturated with the urine, which infects the room with its offensive smell. It would, however, be easy to obviate the evil to some extent, by adapting a caoutchouc bag with a proper rim to receive the protruded membrane. The bag could be emptied from time to time, and changed occasionally ; and in this way, by great attention to cleanliness, the individual might be rendered tolerably comfortable.

Another defect of conformation, which, however, affects the urethra, as much as the bladder, consists in the occlusion of the urethra by a fold of membrane, the urachus remaining pervious, and the urine being voided by the navel. Cabrol treated a case of this kind, of which he thus quaintly gives the history[1] :—

" En l'année 1550, estant à la suite de monseigneur de Montmorancy, dans la ville de Beaucaire, sur les quatre heures du soir, fut faict un salue d'arquebuzades pour la garde de la ville, au-deuant de la porte de madamoyselle de Varie, ou pour lors i'estoy assis avec plusieurs damoyselles, ceste scopetrie apporta vn dommage particulier, car le papier de l'une de ces arquebuzades donnant sur le sable, resaillit sur la visage et sur les mains de trois ou quatre, dont je fus appelé pour penser la plus blessée ; en la pensant je senty une puanteur d'vrine si forte que je fus presque contraint de la quitter sans acheuer de la penser, ne sçachant toutefois bonnement iuger d'où procédoit ceste féteur, ou de la blessée ou d'un autre qui tenait la chandelle, mais bien-tost après je fus esclaircy de ce doute par madamoyselle de Varie, qui m'asseura que c'estoit celle qui m'esclairoit qui puoit ainsi, et que son pere donneroit volontiers la moytié de son bien, et qu'elle fust bien guerie. Je la priay de me la faire voir, et m'offris d'apporter tout le remede que je pourrois à son mal ; sur ceste asseurance elle me fut présentée le lendemain matin, et trouvay son ombilic alongé de quatre doigts et semblable à la creste d'un coq d'inde, et qu'elle pissoit ordinairement par l'ouraque. Enfin ayant recogneu son mal, mon appareil estant prest, sur le point que je voulois commencer l'opération, je me representay tout à coup le danger qui en pouvoit advenir, et que la mort seroit inévitable en fermant le trou d'henhaut, si on ne donnoit issue à l'urine par le conduit d'embas ; mais la pitié fut à l'exhibition des pièces, car la patiente qui pouvoit estre agée de dixhuict à vingt ans, n'y vouloit aucunement entendre ; enfin vaincue des prieres du pere et de la mere, consentit d'en faire la montre ; je trouvai l'orifice de la vescie fermé d'une membrane, espesse d'un teston ou plus, le reste bien formé qui fut cause que je m'attaquay premièrement à ceste partie inférieure, et ayant faict l'ouverture, luy mis une canule de plomb, jusques au dedans du corps de la vescie, pour tenir le conduict libre, et faire que l'urine eut son naturel passage par la : le lendemain je proceday à l'operation de l'ombilic, et y fis une ligature pareille à celle des opérateurs lorsqu'ils couppent une enterocele, car je fis passer l'éguille trois fois par un mesme trou, en embrassant la seconde fois un des costés tant seulement, et la tierce l'áutre, avec un filet fort et bien ciré : cela faict je couppay près de la ligature, cauterisay le bout, et l'escharre tombé, le traittay avec detersifs et dessiccatifs comme les autres ulcères, et fut entierement guerie dans douze jours : par ainsi je m'acquittay fidellement de la promesse que j'avais fait de la guerir : mais je me vis frustré de celle de madamoyselle de Varie, la moitié du bien du pere estant convertie en un double ducat qui me fut donné pour le salaire de ma peine."

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[1] Chopart, vol. i. pp. 338, 339.

A rare variety in the conformation of this viscus has been observed ; where, instead of one, there are two, or even more pouches, each having its own ureter. Molinetti mentions an instance in which he found five different bladders, and five kidneys, with six ureters, two of which terminated in the largest of the bladders, the other four were inserted, one into each of the lesser bladders, each of which poured its urine by separate conduits into the large bladder. This is a very extraordinary, and, perhaps, an unique case.

The preceding varieties of malformation are congenital. The changes of form, size, and structure, which the bladder is found to undergo from disease affecting itself, or neighbouring organs, will be noticed in connexion with the causes which produce them.

The following case, for which I am indebted to my friend Mr. Bennett Lucas, is a very curious, and I believe also, an unique instance of congenital malformation of this viscus.

"A. B., a male infant, five days old, presented in the situation of the anus, a red fleshy-looking tumour, about the size of a pea, which concealed an opening only capable of admitting a small tube, but to the depth of from three to four inches. Nothing had ever been passed in this channel ; the child discharging both its urine, and fæces through the urethra. Both testicles had descended, and a congenital hernia existed on either side. With these exceptions the infant was otherwise well-formed, healthy, and of the ordinary size. I proposed to Mr. Kenney, in company with whom I saw the case, to perform an operation, with a view to establish a connection between the rectum and anal aperture ; but as no very great hope, much less decided success, could be held out from its performance, the parents objected to the operation being attempted, and the little patient died on the evening of the ninth day of its birth.

"Two days before the infant expired its scrotum became distended, and evidently contained a fluid. An incision was proposed to be made into the tumour, but it would not be permitted.

"From the haste attending the removal of the parts, I lost sight of the termination of the ureters, as also the termination of the vasa deferentia. I have, however, since the accompanying sketch of the parts was taken, slit up the remaining portion of the undivided urethra, and, with the greatest care, examined its mucous surface, and also the mucous surface of the bladder, but I could not detect any openings besides those already mentioned.

"As the child passed urine through its urethra, there can be no doubt but that this secretion was received into the bladder ; and as no trace of any opening, except the recto-vesical, the ano-vesical, and the urethro-vesical, can be detected, the urine must have been conveyed, in the first instance, into the large intestine, and thence into the bladder, by means of the recto-vesical opening.

"I am unable to say at what point each ureter entered the large intestine, having brought away only the length of intestine shown in the engraving, which includes all the rectum, such as it is, and a portion of the sigmoid flexure of the colon ; and so far as this much of the gut is concerned, the only opening it presents is the recto-vesical. The ureters probably opened into the corresponding ascending and descending portions of the colon. But this can be only conjecture.

"The course of the vasa deferentia was also destroyed in the hurry of removing the parts ; but there is no opening in the urethra, bladder, or the portion of large intestine, to indicate that they terminated in any of these organs.

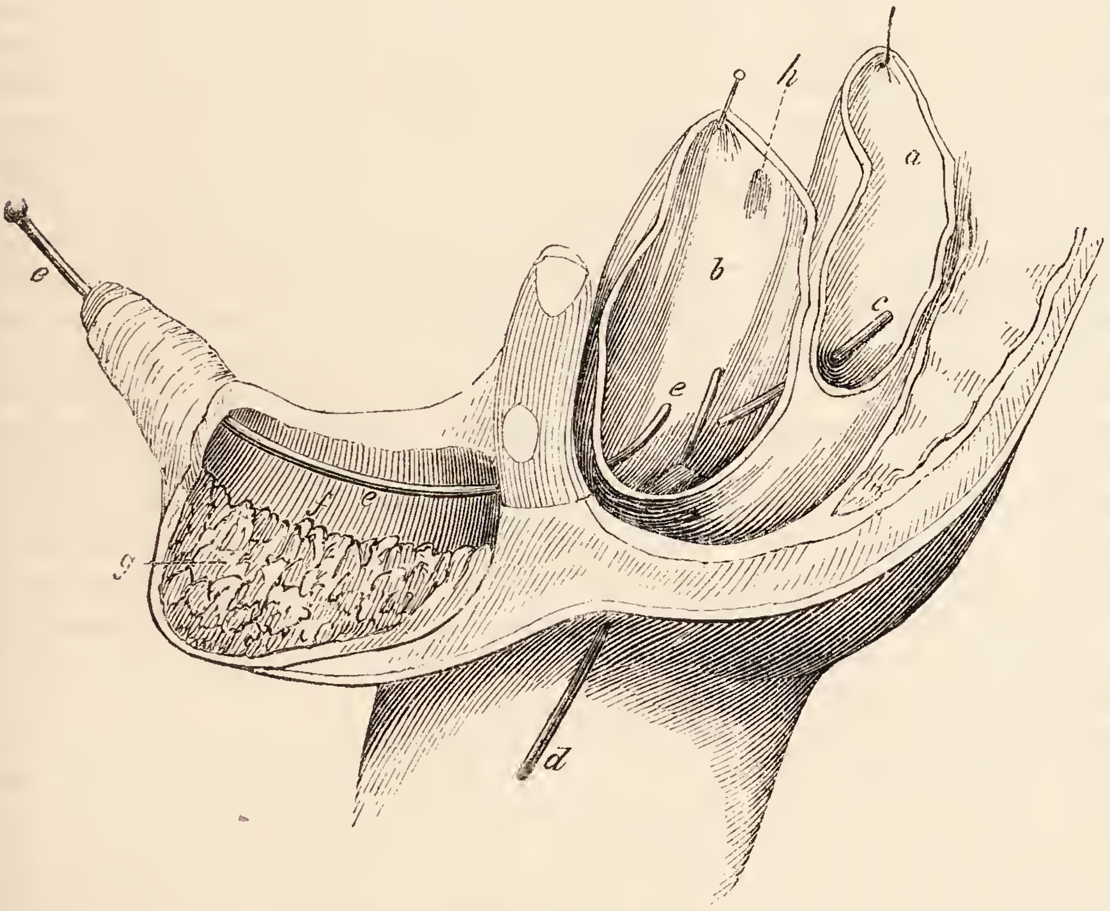
"The urethra does not present a trace of the verumontanum. I also looked most carefully for the prostate gland, and vesiculæ seminales, without success.

"The appearances revealed by the dissection of this, I believe, unique condition of parts, were very different from what was anticipated. Although the infant passed both fæces and urine through its urethra, it was a reasonable inference that the anal orifice communicated with the rectum, in consequence of the depth to which the probe passed: the extremity of the probe, on being withdrawn, being sullied with fæces, and this being the natural outlet of the alimentary canal. The usual orifice, also, and the canal leading from it, being so uneven, as to offer a serious impediment to the passage of the fæces in this direction. Notwithstanding it was evident during life that a communication must have existed between the bladder and rectum; yet under the supposition that the anal orifice communicated with the rectum, all hope of success from an operation which had for its object the restoration of the lower portion of the intestinal canal, was not shut out, particularly when we recollect, the rapidity with which abnormal openings in childhood close, when once the cause which tends to keep them open is removed.

"In this case, however, I doubt if any operation, even were the state of the parts beforehand ascertained, would have been attended with a favourable termination.

"The subjoined sketch of the parts is taken, from the preparation in my possession, by my intelligent pupil, Mr. Meiban:

Fig. 154.



"*a. The rectum, terminating nearly two inches from the anal aperture.*

"*b. The bladder.*

"*c. A probe passed through a small opening by which the pouch-like termination of the rectum communicated with the bladder.*

"*d. A probe passed from the anal aperture upwards, showing its determination in the bladder; the vesical orifice being guarded by a valvular fold of mucous membrane.*

"*e. e. e. A probe passed from the external orifice of the urethra along that tube into the bladder.*

"*f. The distended portion of the urethra, the diameter of which is equal to a No. 11 bougie.*

"*g. The distended scrotum communicating with the urethra for fully half its length, and lined with a coating of lymph, which presented extravasation of the urine, and the liquid fæces into the cellular tissue.*

"*h. A small cul de sac corresponding to the urachus.*"

Bibliography.—Observations on Malformations of the Bladder will be found in *Blasius*, part 4. obs. 6. *Stalpart Vanderwiel*, t. 2. p. 256. *Bartholin*, cent. 2. Hist. 65. Philos. Transact. vol. vii. *Haller*, Elem. Phys. t. vii. p. 297. *Duncan*, Edin. Med. and Surg. Journ. vol. i. *Roose*, Thesis de Vesicæ Prolapsu nativo. *Tenon*. Mém. de l'Acad. des Sciences, Paris, 1761. *Tiébault*, Journ. Gén. de Méd. t. xxxiv. p. 178.

(*W. B. Costello.*)

BLEEDING. See Blood-Letting.

BLENORRHAGY, (from βλέννα, *mucus*, and ῥέω, *to flow*,) is now supplanting the term 'gonorrhœa,' as designating an inflammatory muco-purulent discharge from the urethra, in both sexes, and sometimes also from the glans and prepuce in the male (Balanitis,) and from the vagina in the female. (See Urethritis.)

BLENORRHŒA, (*Gleet*, Eng.) This affection differs only from blenorrhagy, in the absence of the inflammatory symptoms, and in the matter of the discharge being much diminished, more consistent, or sometimes almost limpid. Gleet is not unfrequently symptomatic of stricture in the urethra.

BLEPHARITIS, see Palpæbræ.

BLEPHAROPLASTY, see Restitution of Lost Parts.

BLEPHAROPTOSIS, see Ptosis.

BLISTER, *vesicatorium*, Lat.; *vesicatoire*, Fr.; *Blasenzieher*, Ger. By blistering is meant an elevation of the cuticle from an effusion of serum, caused by the action of some external irritant. The use of vesicants may be traced back to a very remote period in the history of medicine. Myrepsus informs us that Æsclepiades invented a blister under the name of *anthemeron*, and Cælius Aurelianus another called *diacopregias*. Aretæus appears to have been the first to introduce cantharides for this purpose although, if we believe Ætius, it had been previously used by Archigenes and Galen[1].

The common blistering plaister is prepared with the *meloë vesicatorius* of Linnæus, the

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[1] Leclerc, Hist. de la Médecine, p. 513.

lytta vesicatoria, *cantharis vesicatoria* of more recent authors. This remarkable property of the above named insect depends on a peculiar principle, chiefly residing, according to M. Farmes, in the interior of the abdomen and thorax. The head and shining parts seem to be destitute of the substance in question. The cantharidine or epispastic principle, may be procured in the form of white crystalline scales, insoluble in water, but soluble in ether, boiling alcohol, and oils. It is acrid and corrosive. The hundredth part of a grain applied to the lips is sufficient to raise a blister in a quarter of an hour; reduced to vapour, it promptly determines vesicular inflammation of the conjunctiva. Cantharidine dissolved in oil has been also recommended as a substitute for the ordinary *emplastrum cantharidis*[1]; and M. Bretonneau assures us, that paper imbued with this solution acts with great promptitude and energy. It is said that a tincture prepared with three parts of powdered cantharides and eight of sulphuric ether, is capable of producing vesication in the short space of ten minutes[2].

There are several plants, containing an extremely irritant oily or resinous principle, which have the power of blistering the skin. Among these may be enumerated various species of ranunculus, euphorbia, daphne, and urtica. The volatile oil of mustard seed is perhaps the only vegetable epispastic now employed. It is remarkably active in its operation.

Mons. Pigeaux has proposed the sudden combustion of a minute quantity of spirit of wine as a ready means of effecting instant vesication. His process as described in the second volume of the Bulletin de Thérapeutique, p. 176, is the following: cut a circular patch of linen, cloth, or paper of the requisite size, imbue it thoroughly with spirit of wine, and apply it accurately to the skin, previously shaved if necessary; pass a lighted match rapidly along it, so as to set the whole on fire at one and the same moment. The flame thus kindled is extinct in fifteen seconds, after which the epidermis separated from the chorion may be detached either with the point of the nail, the finger, or a bit of lint. The circular patch which had been soaked in spirit, appears perfectly dry and unscathed after the operation.

MM. Récamier and Trousseau, have obtained a prompt vesication, or at all events a prompt and complete separation of the cuticle, by applying to the skin circular layers of lint, soaked in a highly concentrated solution of ammonia. A compress spread with an ointment prepared by incorporating equal parts of caustic ammonia, and hog's lard, answers the same purpose, provided it be fresh made.

We find the following notices of the modes of preparing blisters by MM. Bretonneau and Trousseau, as well as that of Mr. Johnson in a new periodical called *The Chemist*, published by Hastings.

"*Blister of Bretonneau.*—To prepare this blister, oil is mixed with the powder of cantharides, in such a manner as to give it the consistence of an electuary. A sheet of paper is then taken, in which is cut an aperture of the size and form to be given to the blister; this sheet of paper is then stuck upon a piece of adhesive oil-cloth, afterwards, with a spatula, is spread, in the circle formed by the sheet of paper, a layer of the epispastic mixture, of which the thickness should not exceed one or two millimeters; the sheet of paper is then raised, and in this manner the pomade remains upon the oilcloth, without superfluity and accurately circumscribed.

"The cantharides are then covered with a piece of blotting-paper, which extends beyond them, and adheres to the oil-cloth. The oil-paper, impregnated with cantharadine, penetrating the blotting-paper, comes in contact with the skin, and these blisters join, to an extreme activity, all desirable cleanliness.

"*Blisters of Mr. Johnson.*—Mr. Johnson takes the English blistering plaster of the Pharmacopœia and when it is spread he rubs over it a light layer of the oil of cantharides in ether.

"This oil is that which serves for the confection of blistering taffety; it is prepared in the following manner, according to the new Pharmacopœia.

"Powder of cantharides, 1000 gram. 2 liv.

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[1] The Parisian codex contains two different formulæ for blisters. In the one the cantharides partly cover the plaister; in the other they are wholly incorporated. The first is composed of three parts of Burgundy pitch, one of turpentine, two and a quarter of yellow wax, and one and a half of cantharides, reduced into fine powder. It is recommended before being applied, to sprinkle the surface with a fresh quantity of cantharides, and if need be, with a few grains of pulverized camphor. The following is the formula for the second, the *vésicatoire Anglais:* mix equal parts of wax plaister, axunge, and powdered cantharides. It is preferable to the former. The *emplastrum cantharidis* of the London Pharmacopœia, is made with two parts of cantharides in very fine powder, three parts of wax plaister, and one of prepared lard.

For the sake of convenience and rapidity, it has been proposed to substitute for the preceding, various sparadraps containing the active principles of cantharides, euphorbium, and mezereon.

[2] An Italian pharmaceutical chemist named Venturini has recently published the formula of a blistering taffeta, which he says acts perfectly and promptly, and has none of the inconveniences which sometimes follow the use of the ordinary *emplastrum cantharidis*. He directs of cantharides in powder one pound, of resin of euphorbia in powder three ounces and a half, and of alcohol, at 35°, five pounds. The solid ingredients are to be boiled a few minutes by means of a water bath, in an earthen vessel, not hermetically closed, along with two pounds of the alcohol; and after twelve hours' digestion, strained and filtered. What is left behind is to be treated by the remaining three pounds of alcohol, and after two hours' digestion, again strained and filtered. The two portions of liquor are to be mixed together and distilled, so as to obtain on the one hand the alcohol, on the other the alcoholic extract. This is to be combined with an ounce of isinglass dissolved in an infusion of two ounces of the bark of mezereon, and a pound and a half of water, reduced to ten ounces by gentle evaporation. The preparation thus terminated, is to be rapidly spread with a hair-pencil upon black taffeta, which is afterwards cut into pieces for use.—(*Gazetta Ecclectica di Chimia*, *Avril*, 1839).

"Sulphuric ether a sufficient quantity.

"Make an etherial tincture of cantharides by lixiviation in a movable apparatus; distil this tincture to drive off the ether; and a green, thick, and very vesicant oil will be thus obtained.

"Blisters thus prepared are very active; but M. Trousseau prefers the following to them:

"*Blisters of M. Trousseau.*—A piece of blotting-paper is cut of the form and size of the blister that is desired; it is applied upon a sheet of diachylon; and it imbibes some drops of the extract of cantharides by ether, and it is fixed upon the skin by means of the diachylon.

"M. Trousseau has tried comparatively the action of different blisters; he has found that that which is prepared with the etherial extract of cantharides was the most energetic; the blisters of Bretonneau came next before the ordinary blister, and even the English one.

"Another advantage which M. Trousseau found in his blister, is that of being very portable. 'Indeed,' says he, 'I have lightly imbibed with the etherial extract of cantharides a sheet of blotting-paper, which I have kept in the dressing apparatus of the hospital in the open air for fifteen days. The time having expired, I examined it; on its surface were seen small silky needles of cantharadine; I applied a blister cut from this sheet; it took effect at the end of eight hours. You will easily agree, that for our brethren who practise in this country, and who are obliged to carry medicaments with them, it will be especially convenient to have in a pocket-book, and under cover, a large sheet of cantharadised blotting-paper, from which will be cut blisters as large as may be desired.'

"These blisters have acted in the space of from six to nine hours upon two women, and from seven to twelve hours upon ten men. The mean has been from eight to nine hours."

Boiling water has been occasionally employed as a means of inducing rapid and extensive vesication. A sponge or cloth dipped in the liquid, is placed upon a surface of the skin, equivalent to the extent of vesication we wish to obtain, and immediately removed to prevent the risk of producing an eschar. Sir A. Carlisle has proposed the momentary application of a spatula heated by immersion in boiling water; a modification which may be reckoned more eligible and no less efficient.

When an epispastic remains for a certain time in contact with the skin, it gives rise to a feeling of pricking and burning, the part becomes red, tense, and tumid, and a quantity of serum being effused by the capillaries, the cuticle is elevated in the form of a vesicle. The effect induced is termed "revulsion," "antispasis," or "derivation;" and it is said by Conradi (Handbuch der allgemeinen Therapie, s. 91.) to be exerted "when a topical congestion, or stimulation, or other affection of a part, leaves that part, and is drawn towards another, and usually less important part." To suppose that blisters act solely by the discharge they create is erroneous. It is the counter-irritation which is the great sanative principle, and this may be obtained without vesication. Bégin observes that the effect of blisters is to elevate the organic actions in parts to which they are applied, or towards which their action is directed, and that are more or less remote from the inflamed organs. So that independently of their revulsive agency, blisters excite the affected capillaries, and act in the same salutary manner as internal tonics and stimulants.

The immediate result of their action is inflammation generally terminating in effusion, which varies in degree according to the intensity of the agent on the one hand, and the irritability of the subject, on the other. If too feeble, we have rubefaction only; if too powerful, high inflammation and suppuration.

It is a singular fact that vesication may be established without the existence of animal sensibility. The author of the article, "Vésicatoire," in the Dictionnaire de Médecine et de Chirurgie Pratiques, instances a case where he has seen it completely produced, and followed by suppuration on the thigh of a paraphlegic subject labouring under compression and ramollissement of the spinal marrow. The inferior half of the body was entirely deprived of sensation and motion; the patient did not feel the blister, nevertheless an incontinence of urine, with which he was affected, was replaced by a retention of urine, which lasted several days.

Blistering has been resorted to in the treatment of the following surgical diseases.

1. In acute inflammation, but is inadmissible before antiphlogistic means, capable of modifying the inflammation, or reducing the general febrile state have been employed.

a. In inflammatory affections of the eye, and palpebral glands. In almost all cases will it be found useful in the second stage, but more particularly in the rheumatismal form of ophthalmia. In strumous ophthalmia, especially when the corneal surface is affected, and the sensibility is from this cause painfully augmented, after previous evacuations, counter-irritation, by blistering alternately behind the ear and the nape is useful. Blistering the nape is likewise advantageous in purulent ophthalmia, after depletion; as also in catarrhal ophthalmia, ophthalmia tarsi, retinitis, and in abscess of the cornea. In iritis, Mr. Lawrence is of opinion, that blistering often adds to the excitement, instead of lessening it; particularly if applied near the affected organ. As a general rule, in active inflammation, blisters should never be placed nearer to the eye than the nape of the neck, or the mastoid region. When they are applied to the forehead, temple, or side of the cheek, observes Mr. Lawrence, the inflamed organ may be included within the sphere of their irritation, with aggravation of the local symptoms, and prove decidedly injurious[1].

b. In inflammation of the external ear, when of a rheumatismal character, or occurring metastatically, as after scarlatina. In internal ear-ache, if after the employment of blood-letting, and other active means, the discharge continues, with dull pain deep in the ear, or in the site of the mastoid process, the application of a blister once or twice, is often followed with abatement, and ultimate cessation of the discharge, says Dr. Craigie. While in otitis, blisters have been found to aggravate the disease, and are reported to have produced, in some instances, when applied for a different purpose, inflammation of the auditory tube.

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[1] A Treatise on Diseases of the Eye, p. 112.

c. In inflammation of the synovial membrane of joints, blistering is advantageous, but requires to be often renewed. The blister should be of a considerable size ; and if the affection be deep-seated, ought to be applied so as to embrace the sides of the articulation, because in that situation the capsule is covered only with a very thin aponeurotic expansion, cellular tissue, and skin. Where the affection is not deep-seated the blister is frequently of more service, according to Sir Benjamin Brodie, when applied at a little distance. For example ; if the synovial membrane of the hip be inflamed, the blister may be placed on the groin and nates ; but if it be the wrist-joint which is affected, on the lower part of the fore-arm. Under this treatment, the pain is usually relieved, and the swelling, in a few days, greatly diminished. Even when the tumour is solid, arising from the effusion of coagulable lymph, it will, in a considerable degree, subside, and sometimes be entirely dispersed, provided the lymph has not become organized[1]. However beneficial blistering may be, it ought never to be employed in such cases without the previous abstraction of blood, except where the signs of inflammation are almost null, and where the fluid is simply serum. The same line of treatment may be pursued in inflammation of the bursæ mucosæ, and of the membranes forming the sheaths of tendons, in the early stage of the disease preceded by leeches, and cooling lotions, as also at a more advanced period, when the preternatural secretion of fluid continues after subsidence of the inflammation.

d. In phlegmonous erysipelas, blistering has been recommended by a French surgeon, M. Petit of Lyons, applied over the centre of the blush. It is said to favour the resolution of the inflammation of the cellular tissue[2]. MM. Patissier and Olivier have drawn up some observations on the subject, deduced from the hospital practice of Dupuytren, in corroboration of the efficacy of the practice in the second period of the disease. The presence of gastro-enteritic symptoms is said by Lisfranc to be a contra-indication to its use.

e. In inflammation of the lymphatic glands, and more especially in those of the groin. In cases of torpid bubo, blistering may act either in preventing the formation of matter, or in promoting its absorption, if already formed. I have seen patients labouring under this affection, where purulent fluctuation was distinctly perceptible, to whom a blister was applied, and the blistered surface subsequently dressed with lint, soaked in a solution of sublimate (one scruple to an ounce of distilled water). The result being a gradual transudation of the pus through the skin, and a perfect cure in eight or ten days.

f. In chronic catarrhal inflammation of the bladder, repeated blistering of the loins sometimes relieves the sense of internal heat and pain, and moderates the quantity of mucus discharged. Care must be taken, however, to guard against absorption of the cantharadine in such cases.

2. In paralytic affections, as in amaurosis, independent of organic lesion, the use of blistering has been advocated by Dupuytren and Guersent. And, certainly, where the antiphlogistic treatment, and a fair trial of mercury have failed to do good, blisters may be tried, sometimes as temporary irritants only, in others as irritants and drains. Mr. Lawrence recommends a succession of blisters, applying a new one to a fresh surface every five, six, or seven days, either behind the ears, or at the side or back of the neck[1]. Professor Rosas of Vienna, advises, in what he denominates *amaurosis torpida*, the application to be made to the outside of the orbit, or over the scalp[2].

3. Blisters are occasionally employed as a preventive measure against metastatic abscess, and also for promoting the maturation when pus is already formed. They afford likewise a useful drain in the healing up of old sores.

Application.—Blisters may be applied to any part of the surface, provided its epidermis be moderately thin. The precise spot depends on the indication we desire to fulfil. If the part selected be covered with hair, it ought to be previously shaven, otherwise vesication is imperfect, and the subsequent dressings occasion needless pain. The epispastic material may be spread on adhesive plaster, or leather, but I am disposed to consider the former preferable ; and after being applied may be lightly supported, if necessary, with the turn of a roller. All constriction must be avoided, as tending to impede the action of the remedy. After remaining in contact for six, nine, or twelve hours, according to circumstances, it may be removed. Should it not have produced the full effect, a complete blister will be raised by covering the part with lint, spread with fresh cerate, or with a soft warm poultice. The patient thus escapes the irritant action upon the neck of the bladder, which is apt to follow the prolonged application of the cantharides. A great improvement, introduced by M. Bretonneau, is the interposing, between the blister and the skin, a single sheet of fine tissue paper, through which the vesicating principle (cantharadine), from its solubility in oil, easily acts; and all the evils which result from the absorption of the cantharides are prevented. Strangury scarcely ever occurs; and it will be found, that in many cases of disease, this mode of blistering may be used at a much earlier period than under the old system. It is necessary to proceed cautiously with blisters in young subjects; they should never be left on longer than six or eight hours, and never irritated with acrid dressings. Mr. Lawrence mentions his having seen fatal mortification to ensue, from a neglect of these precautions. It should, moreover, be borne in mind, that the operation of blisters is very different in different individuals, as regards their susceptibility. The irritation and discharge of an efficient blister as big as a crown will sink the powers of a delicate female for days.

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[1] Treatise on Diseases of the Joints, p. 36.

[2] The effect of blisters enveloping an entire limb in inflammation of the absorbents as recommended by M. Velpeau, has been already noticed in the article, ANGEIOLEUCITIS.

[1] Op. cit. p. 259.

[2] Lehre von den Augenkrankheiten, p. 95.

If it be the intention to rouse the patient from a state of profound lethargy or coma, we must, after incising the surface, or even without this precaution, lay hold of the dead cuticle and remove it with a brisk pull. Then the pain caused by the contact of the air, and lint with the denuded nervous papillæ of the corium, will produce a powerfully stimulant and revellent effect. When, on the contrary, it is desirable to spare the feelings of the patient, we simply incise the vesicle in a circular manner to give issue to the accumulated serum, and place gently upon the shrivelled cuticle a soft compress thinly spread with fresh and well washed lard or cerate, which may be warmed a little, to render it more congenial. The vesicle being thus partially evacuated, we facilitate the discharge of the remaining fluid by puncturing the unopened portions of the epidermis, and proceed as described. In this way the dressing is accomplished without annoying the patient. Where undue compression has been employed, or the patient has been very restless, the vesicle will be found ruptured, and the flaccid epidermis separated from the rete mucosum by a layer of concrete albumen.

The oil-silk dressing may be used with advantage for blistered surfaces. An American writer has suggested the use of finely carded cotton, which has also been found to answer well[1].

Although intermittent revulsion be more efficacious than permanent, yet there are particular instances in which it is expedient to maintain for some time the discharge from the blistered surface. For this purpose, it may be dressed twice daily with the *ceratum sabinæ*, or *unguentum cantharidis*. The latter is however prone to excite strangury and vesical irritation. The French employ paper impregnated with the active principle of mezereon (*papier épispastique à garou*); and a pharmaceutical chemist in Paris, named Le Perdriel, has prepared a kind of fine oil-silk imbued with the same substance, which he calls his *taffetas épispastique*. For the first dressing the taffetas is to be smeared over with a thin layer of cerate or fresh butter, but this may be dispensed with afterwards; it should extend for about a quarter of an inch beyond the secreting surface, and be renewed once in the twenty-four hours. The sore ought neither to be sponged nor wiped dry. Should it become torpid and covered with a whitish plastic exudation, a more active preparation of the mezereon is substituted; if, on the other hand, it become painful from any cause, as from a blow, the exercise of two great pressure, or irritant unguents, poultices may be applied at night, and the oil-silk dressing during the day.

In some instances the secretion becomes so acid as to corrode the margins of the sore, which enlarges indefinitely, and is attended with lively inflammation and intolerable itching. Here the edges of the sore are to be encircled with a zone of fine oil-silk, while the centre of the sore may be dressed as described. By gradually diminishing the size of the aperture formed by the zone of oil-silk, we can progressively suppress the discharge; a point of some importance when of long standing. When that is superabundant, we have merely to pierce a number of holes in the taffetas, so as to allow its absorption by the compress, which consists of very soft, smooth, white bibulous paper.

When luxuriant granulations form, they may be kept under by touching them with sulphate of copper or nitrate of silver, or dusting them with the powder of calcined alum, and exercising a slight degree of pressure.

In the event of sloughing, an excellent plan is, to pencil over the part with a solution of silver (gr. x — ℈i to the ℥i), and then apply a warm poultice, as much pain attends the application. To obviate gangrene, fermenting cataplasms are to be employed, the patient at the same time being supported by nutritious diet, in conjunction with quinine and diffusible stimulants.

There is an ingenious contrivance for bandaging, which I have seen in Paris. It consists of a light shield, made of thin plated metal, or gum-elastic tissue, to one side of which a band of the caoutchouc web is attached, provided at its extremity with a clasp, which fastens to the other side of the shield. These are called, according to the part to which they are adapted, *serre-bras, serre-cuisses*, &c., and are used to contain blisters, issues, &c.

(*Alexander Ure.*)

BLOOD-LETTING, *missio sanguinis*, Lat.; *saignée*, Fr.; *Aderlass*, Ger. In this article it is proposed to consider the different modes which may be employed for the abstraction of blood, whether from the arterial, the venous, or the capillary system, to point out the effects of each of these different methods, the various circumstances under which they may be advantageously employed in the treatment of diseases, and likewise the best methods of performing the different operations for blood-letting.

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[1] The late Dr. Wm. Young of Glasgow was in the habit of applying this material. He assured the editor, that if the blister were removed when rubefaction was produced, and the cotton then applied, the vesication would follow equally well, with but little pain comparatively. In blistering young subjects he always had recourse to this plan.

Blood-letting, or the abstraction of a portion of blood from the body, is one of the most powerful means which we possess for the cure and relief of disease, and has been employed as a therapeutic agent, since a very early period of the history of the healing art. The Egyptian physicians, we are told, were led to adopt it from observing the hippopotamus on particular occasions come out of the river, trample his gigantic feet against the sharp point of some broken reed, by which he lacerated the skin, and caused a copious bleeding. We read also of savage tribes, who, when afflicted with feverish disorders, cause a flow of blood by lacerating some parts of the skin with the sharp edges of broken shells. It is easy to imagine how mankind, even in a very rude state, must have been struck with the immediate relief of painful sensations in the head by the spontaneous loss of some blood from the nose, and of disorders in the chest and abdomen being subdued by the coughing, vomiting, or purging of blood. No rational system for the employment of blood-letting was however established until after the phenomena accompanying spontaneous hæmorrhages were noticed, the signal relief which they afford observed, and the mischievous effects of their suppression well understood. The abstraction of blood has since been gradually adopted in the practice of medicine, and though various opinions have been at different periods entertained as to the circumstances which indicate its use, and the extent to which it may be employed, yet its utility, when judiciously resorted to, is universally admitted.

As the blood is the agent on which the action of the heart depends, alterations in its quantity modifies the action of the central organ of the circulation, and hence whenever the heart is unusually excited, as is the case in all the inflammatory diseases, accompanied with fever, the abstraction of a quantity of blood becomes a powerful means of subduing its movements.

A similar effect of abstracting blood is produced in *local inflammation*, wherein the action of the heart is not disturbed; the diminution of the quantity of the blood in an inflamed part by diminishing the stimulus produced by that fluid, causes not only a temporary subsidence of the over-distension of the vessels, but checks their future increase, and thus subdues the diseased action of the vascular system in the affected part.

The abstraction of blood from any part or organ where there is a simple congestion or plethora, affords also signal relief, by permitting the capillary system to contract and free itself from the surplus quantity of the sanguineous fluid. It is also had recourse to for the relief of some diseases, wherein changes have taken place in the qualities of the blood itself.

The curative effects of blood-letting, whatever be the explanation given of them, are strikingly exemplified by the beneficial influence derived from *spontaneous hæmorrhages.* Indeed the most powerful means which we possess for the cure of diseases, produce their good effect by strictly imitating the processes which nature herself employs, or which are resorted to by the *vis medicatrix naturæ.* Sickness, vomiting, purging, perspiration, are each in their turn artificially produced with the view of subduing diseases, and are likewise those very means which are employed by the system itself to effect similar curative processes. Examples of the good effects derived from *spontaneous hæmorrhages*, may be observed in several parts of the body. Many persons who have suffered from a congestion of blood in the head, are completely relieved by the escape of some blood from the surcharged capillaries of the Schneiderian membrane (*epistaxis*). Others are in the habit of losing, and that too at regular periods, a considerable quantity of blood from the rectum (the *hæmorrhoidæ flux*), an event which seldom fails to relieve some disturbance of the health arising from congestion in the portal system.

Spontaneous hæmorrhages also take place from the bronchi (*hæmoptysis*), and prove the means of removing congestions in the thoracic viscera. Blood too is frequently discharged by the bursting of *varicose cutaneous veins*, and such hæmorrhages are always more or less efficacious in removing some internal malady. Even in *malignant diseases*, such as cancer and fungus hæmatodes, occasional hæmorrhages, to which such affections are liable, though as in other spontaneous hæmorrhage, the flow of blood may sometimes be unnecessarily profuse, yet the depletion often has a salutary effect, relieving the congestion of the vascular system with which such tumours are so often accompanied. The same relief is also observed to take place from those hæmorrhages which so frequently arise from *sloughing ulcers*, the flow of the blood subduing that violent inflammation which caused the sloughing of the soft parts. Beneficial effects likewise follow the *secondary hæmorrhage*, which so frequently occurs after wounds inflicted, either accidentally or in the course of operations.

Differences in the effects of abstracting arterial and venous blood. Blood may be abstracted either from the arterial (*arteriotomy*), the venous (*phlebotomy*), or the capillary systems (*topical blood-letting*), and it is of much practical importance to consider what are the differences in the effects of these different modes of blood-letting, in order that our choice of any one of them in the treatment of diseases may be the more judiciously determined.

It may be expected that the loss of a

pint of arterial blood will produce a different effect on the circulation from that of an equal quantity of venous blood, and moreover, that the same quantity taken from the capillary system, will produce effects different both from a venous and arterial blood-letting, for when leeches or cupping are employed, both venous and arterial blood will be at the same time removed.

The chief reasons usually given for opening an artery in preference to a vein, is that the blood is obtained from an artery more promptly, in a larger quantity, and more directly from the affected part. But as the temporal artery is almost the only vessel upon which arteriotomy is usually performed, we know little of the curative effects produced by abstracting arterial blood, except when it has been taken from that vessel; and I have generally found, and I believe this coincides with the experience of many others, that the inflammatory symptoms recur much more frequently after blood has been removed from an artery, than if an equal quantity had been taken from a vein.

The effects of opening the temporal artery in puriform ophthalmia, or conjunctival inflammation, distinctly shows the difference in the effect of arterial and venous depletion in the treatment of inflammation. An eye, completely injected with red vessels, will be suddenly relieved by opening the temporal artery, and the conjunctiva will become quite pale, inducing one to suppose that the inflammation is subdued. But generally, sooner or later, even in a few hours, the redness and pain return; whereas had a vein in the arm been opened under similar circumstances, and an equal quantity of blood removed, the good effects of such a blood-letting would have been permanent.

A little reflection may assist in explaining how this difference of effect is produced. When blood is abstracted from an artery, there is an immediate diminution in the supply of blood to the part nourished by that artery; but such is the vigour of the anastomosing branches, that the supply which is thus cut off is very quickly restored. This fact is confirmed by observation. If a ligature be placed upon one of the carotid arteries, almost immediately the temporal and occipital branches of the carotid of the opposite side of the head may be distinguished through the integuments, dilating, becoming tortuous, and struggling, as it were, to circulate an additional quantity of blood. I was first led to make this remark in the case of a child, on one of whose carotid arteries I had placed a ligature for the cure of a very large nævus of the cheek. Almost immediately after the operation, the frontal, temporal, and occipital arteries of the opposite side of the head began to enlarge, increase in their action, become tortuous, and were actively employed in performing the function of those vessels whose channels had been obstructed. Indeed it was a knowledge of this function of the anastomosing branches of the arterial system when a trunk is obliterated, which led Hunter to perform the "high operation" for popliteal aneurism. The same interesting phenomena are exhibited in the eye, when an artery on the sclerotic conjunctiva, passing into a speck upon the cornea, is divided. Vessels conveying red blood will then be immediately perceived stretching across the cornea from the opposite side, to supply the place of the vessel which had been destroyed.

Whenever, therefore, the supply of blood to any organ is diminished, the arterial system, by a wise provision of the economy, the *vis conservatrix naturæ* makes an effort to throw blood by another channel, to that part which has been deprived of its natural quantity, and thus the action of the heart and arteries must be more or less increased. But the abstraction of blood from a vein is followed by no such increased action of the heart and arteries; there is no local diminution in the supply of arterial blood, no effort made by the arteries to supply the place of the venous blood which has been removed. On the contrary, the diminished supply of venous blood to the heart, by the operation of phlebotomy, will have the effect of diminishing the vigour of the heart's action, and consequently that of the whole arterial system.

There is, therefore, an important difference between the changes which take place in the action of the vessels of a part, when blood has been taken from an artery and from a vein; and one proof that the abstraction of venous blood is the most useful in the cure of disease is, that in those natural or "spontaneous hæmorrhages" which are so salutary, such as those from the nose and hæmorrhoidal vessels, the blood which is discharged appears to be chiefly venous. Where leeches and cupping are had recourse to, it no doubt happens that they remove both arterial and venous blood at the same time; but the circumstances under which these operations are performed, do not furnish us with any opportunity of discriminating the comparative effects of the abstraction of venous and arterial blood.

LOCAL AND GENERAL BLOOD-LETTING.

When blood is abstracted from an artery, or from a vein, it is called *general* blood-letting; and if it be removed by leeches or cupping, it is called *local* or *topical* bloodletting. This distinction is highly useful for practical purposes, though, strictly speaking, it may not be deemed physiologically correct, for it is evident that a local bloodletting may be carried to such an extent as to influence the whole system, and that a *general* blood-letting may produce on the disease of a particular part all the effects of a local bleeding.

Blood-letting has also been denominated *derivative* and *revulsive;* terms employed to denote particular effects, which are produced by the abstraction of blood according to the different methods of performing the operation. It is called *derivative*, when the blood is removed from the immediate vicinity of a diseased organ, and *revulsive*, when the blood is removed from vessels situated at a distance from the diseased part, such as by leeches applied to the feet, in affections of the head, chest, or abdomen.

Local blood-letting.—Strictly speaking, there are few parts of the body from which blood can be abstracted locally, for blood taken by leeches or cupping from the integuments covering a diseased organ, often comes from vessels which are not ramifications of, and have no direct communication with, the vessels of the diseased organ. Thus, blood taken from any of the branches of the external carotid, as the temporal arteries in the treatment of diseases of the encephalon, cannot be considered as local bleeding, from the distant and circuitous connexion those vessels have with the internal carotids. Neither, for like reasons, can blood taken from the parietes of the chest or abdomen, be considered as strictly local bleeding in affections of the thoracic or abdominal viscera. The opening of a vein in the arm abstracts blood more directly from the jugular veins and encephalon, as well as the superior and inferior cavæ, than leeching or cupping the integuments of the temples, forehead, thorax, or abdomen. General bleeding is, therefore, a more local mode of taking away blood in the treatment of various affections of the brain, and of the thoracic and abdominal viscera, than that which is usually resorted to, and commonly considered, as local blood-letting.

Local or topical bleeding, strictly so called, can, indeed, be employed only on a few organs, and in a few parts of the body. In the treatment of diseases within the cranium, topical bleeding can be accomplished by taking blood from the ethmoidal vessels, or from the frontal vessels, both of which come from the encephalon. It may be also taken from the vessels behind the mastoid process of the temporal bone, the artery being a branch of the occipital, which goes to the dura mater, and the veins communicating directly with the lateral sinus. As the frontal artery is a ramification of the ophthalmic, and as the ophthalmic artery comes from the internal carotid; and passes through the orbit to reach the forehead, blood taken from that vessel, must be, strictly speaking, a more local bleeding in diseases of the head and globe of the eye, than blood taken from the temporal artery—the temporal artery being a branch of the external carotid.

On this account, in diseases of the head, as well as in diseases of the eye, more particularly those affecting the internal parts of the globe, leeches applied on the frontal vessels, give much more relief than can be obtained by abstracting an equal quantity of blood from the temporal vessels, by leeches applied to the temples.

Leeches applied to the septum of the nose, may also be considered as a local bleeding in diseases of the encephalon, for in such cases the blood comes from the ethmoidal vessels, which are branches of the internal carotids, which pass through the cribriform plate of the ethmoid bone, and ramify on the Schneiderian membrane. I have frequently known cases of affections of the head, which, after resisting general bleeding, and also the application of leeches on the head, were instantly relieved by the escape of even a few drops of blood from the nose. The effect of losing a small quantity of blood locally, is, indeed, often surprising. Of this I might give some remarkable illustrations. An instance of this kind occurred in a lady, who, after employing local and general bleeding for a disorder in her head, applied to an itinerant, celebrated for curing headachs. He introduced an instrument into the nose, by which he wounded the Schneiderian membrane, and produced a flow of blood; and the evacuation which followed, completely cured the headachs. It was in a case of this kind that Galen acquired much renown, by prognosticating that a person would have a flow of blood from the nose, by which the affection of the head would be relieved[1].

I have had many opportunities of testing the comparative advantages of the different methods of abstracting blood *locally* in affections of the head; and I am fully persuaded that the application of leeches, on the lining membrane of the nose, is to be preferred in most cases, especially where the uneasiness in the head is limited to the frontal region. In some cases of chronic inflammation of the eye, and inflammatory affections of the lachrymal sac, I have repeatedly advised leeches to be applied alternately on the nasal septum, and on the skin adjoining the inflamed sac, in order that the effects of each method might be fairly compared. Almost invariably the result has been a decided preference to the abstraction of the blood from the nose. The continuity of the mucous membrane, which lines the nose with that of the lachrymal organs, and the free inosculation of their vessels, will explain the advantages to be derived from this practice in inflammatory affections of the lachrymal sac.

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[1] The good effect of the application of leeches on the Schneiderian membrane may be illustrated by numerous examples. A lady had long suffered from headachs. I advised leeches to be applied within the nose. One was accordingly applied on each side of the septum, and the headachs were permanently relieved.

Another lady, after severe mental affliction, complained of uneasiness in the head, for which blood-letting was employed. She had frequent returns of the headach, and was always relieved by depletion, leeches being sometimes applied behind the ear, on the temples, or on the feet. On one occasion, when a sense of fulness continued in the frontal region, even after the usual means had been resorted to, I advised her to apply a couple of leeches to the nasal septum, and the bleeding had the happy effect of completely relieving her head. Subsequently she had occasional returns of headach, and she found that a small bleeding from the nose never failed to give a more decided relief than she had ever obtained from any other mode of blood-letting.

A young girl had suffered from pain in the forehead for upwards of a twelvemonth. It varied in degree, but never ceased altogether. Her countenance was pale and languid, and the integuments covering the lachrymal sac, and conjunctiva, of the same side, were much inflamed. Besides purgatives she had leeches applied twice behind the ears, but without obtaining relief. One was soon after applied on the nasal septum, and repeated six times, at short intervals. The last leech caused a bleeding, which continued for twenty-four hours, after which she never again suffered from headachs, her general health was completely restored, and the local inflammation subdued. It is worthy of remark here, that the quantity of blood, which sometimes flows from the bite of a single leech, when applied to the septum of the nose is very considerable; so much so, that I never recommend more than one to be applied at once; and should the loss of blood be insufficient, another leech can then be used on the opposite side.

In some cutaneous diseases of an inflammatory character, and where the integuments of the nose are chiefly affected, the application of leeches to the septum may often be beneficially resorted to[1].

Leeches applied behind the ears are well-known to relieve affections of the head, a practical fact, satisfactorily explained by the communication of the vessels of the integuments behind the ear, with those of the encephalon. Immediately behind the mastoid process, and near where the temporal and parietal bones unite, is situated the *mastoid foramen*, through which passes, sometimes, an artery, and always a large vein; the artery is a branch of the occipital, and goes to the dura mater, and the vein comes directly from the lateral sinus.

In the treatment of some forms of *ophthalmia*, scarifying the conjunctiva, or applying leeches thereon, is a useful mode of abstracting blood locally, the good effects of which, when other modes of depletion have been employed, are very striking.

Leeches applied to *inflamed gums*, give great relief, as they also do when applied to the mucous membrane of the vagina in cases of inflammation of the uterine organs.

Bleeding in the jugular veins is also a most useful operation to effect a local blood-letting in affections of the head, particularly in children, where leeches applied to the neck are often dangerous, and where the veins of the arm cannot be opened. For a like reason, a "necklace" of leeches, applied immediately below the chin, has been much recommended by Dr. Veitch, in order to relieve inflammatory affections of the head.

The beneficial effects of local bleeding may also be observed when an incision is made into an inflamed part. We often find, that extraordinary relief is produced by the escape of the blood which flows from an incision made through the inflamed integuments covering an abscess, and that too under circumstances where the accompanying symptoms would not have indicated the propriety of abstracting blood in any other mode. The beneficial practice of making very free incisions through the integuments in cases of erysipelas is also to be explained on the same principle, and the common practice of laying open sinuses while the adjacent parts are in a state of inflammation, owes its good effects entirely to the profuse bleeding which follows the incision. On this point Parry has an observation, the truth of which is receiving constant confirmation, "that the arteries of an inflamed part, if cut, will bleed longer than others of the same size."

Similar good effects may be observed from the flow of blood which takes place when a free incision is made through the inflamed integuments of a finger affected with whitlow, and likewise by dividing the gums during *dentition*.

But independently of relief from the loss of blood, why should we not anticipate as great an alleviation from the discharge of the serum, or sero-coagulable matter effused into the cellular tissue of an inflamed part, as from the discharge of the matter, when it has become purulent? It seems to me a point worthy to be considered, whether in phlegmonous cases it would not be much more advantageous—in many instances of inflammation where there is no rational expectation of preventing suppuration—to make a free incision through the inflamed integuments at an early period, and before any pus has been formed. The evacuation of the sero-coagulable fluid effused in the cellular tissue, and deposited there previously to its conversion into purulent fluid, along with the profuse discharge of blood from the incision made in the integument, might produce not only great relief from pain, but limit and check the progress of the inflammation.

A girl had a large inflammatory swelling on the ulnar aspect of the arm, which was extremely hard and painful to the touch, and the integuments were of a bright scarlet colour. Though no fluctuation could be distinguished, I was persuaded that by freely dividing the skin she must be saved a protracted suffering. I, therefore, made a free incision through the middle of the tumour. It bled most profusely, and I could not detect the escape of any purulent fluid with the blood. A poultice was applied, the inflammation and pain were almost immediately subdued, and the wound granulated and healed rapidly.

I have often witnessed beneficial effects from the local bleeding which takes place after operations, though great pains are generally, and often injudiciously, taken to arrest it. I have frequently had occasion to observe the good effects which the loss of even very considerable quantities of blood during operations has in preventing subsequent febrile symptoms and local inflammations. But it may be here noticed, that whatever quantity has been lost during an operation, however carefully the patient has been prepared before the operation, however careful the surgeon may have been in securing with a ligature every bleeding vessel; still, more or less inflammatory action, accompanied by fever, may supervene, and a hæmorrhage from the wound take place. Under such circumstances little need be feared from the bleeding; and before tying the bleeding vessel, it will be wise either to have the wound exposed, and to allow a sufficient oozing to check the inflammation and the accompanying febrile symptoms, or to take some blood from a vein in the arm, for the same purpose.

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[1] A lady, the integuments of whose nose, and the adjoining portions of the cheek had become red, and covered with tubercles (*acne rosacea*), accompanied with a dull, and almost constant pain in the frontal region, was completely relieved by the repeated application of a single leech to the nasal septum, one of which, according to her own estimation, produced a discharge of no less than half a pint of blood.

I removed the greater portion of the lower jaw of a young woman, who was so deluged in blood that bystanders conceived her recovery to be almost impossible. She remained many hours in a state of syncope, but I avoided therefore giving her any stimulants, in the hope that the fearful wound would not inflame, and be the more likely to heal by adhesion. But notwithstanding all precautions, in a few days she became hot and feverish, and blood issued from a corner of the wound. I used no means to arrest it, and it stopped after a few ounces were discharged, completely alleviating all the inflammatory symptoms.

Whenever, therefore, there is any likelihood of secondary hæmorrhage from a wound, it is of great importance not to be too hasty in dressing it by applying plasters and bandages, so that if any bleeding should take place, all the pain and alarm of undressing the wound are avoided, and the bleeding vessel can, if necessary, be easily secured.

Local Bleeding; when to be employed.—In the treatment of those injuries and diseases wherein blood-letting is to be employed, it is of great consequence to have impressed on the mind some rules to enable us, on all occasions, to make choice of local or general blood-letting. Now it will be found an excellent rule, always to employ *general*, in preference to *local* blood-letting, in such cases of local disease or injury as are attended with, or have created, a disturbance of the general system. Whereas, *local* bleeding ought to be employed in preference when local symptoms only exist; any general symptoms, had they been present, having been subdued by previous general bleeding. A person, for instance, receives a blow upon the head, which creates a good deal of symptomatic fever. He is bled more or less profusely at the arm, and until the febrile symptoms are subdued. A good deal of inflammation of the integuments, however, still continues, to remove which leeches may be judiciously applied. The same observation may be made in the treatment of almost every injury and disease, in which bleeding is necessary. The most frequent error committed in the treatment of those diseases which require blood-letting, is, that local bleeding is employed where general bleeding ought to have been preferred. The reverse practice is seldom adopted; and there seems always a disposition both in patients and in medical men, to economise blood, venesection being unfortunately considered a much more serious operation than the application of leeches; hence leeches are often injudiciously preferred. In many instances of persons who have repeatedly lost blood, from having commenced with local, in place of general bleeding, the consequence is not only that the disease is not so soon checked as if a copious general bleeding had been employed in the first instance, but from the necessity of resorting to a frequent repetition of local and general bleeding afterwards, the whole quantity abstracted greatly exceeds what would have been required for the cure of the disease, had the treatment commenced with an adequate venesection.

Leeches are in a more especial manner preferable to general bleeding in all cases of local injury, before the accession of fever. When a part is bruised, the whole frame receives a shock in proportion to the severity of the accident, and no sooner does the system recover, and reaction take place, than the bruised part becomes more or less tense and painful, which symptoms indicate the commencement of inflammation. If in this state a sufficient number of leeches be applied to the parts, the inflammation will be immediately subdued; and if they be again and again applied, without delay, and in numbers proportionable to the severity of the injury whenever there is any return of pain and swelling, the inflammatory symptoms are completely held in check, and all the evils of the accident are averted.

A gentleman fell from his horse, and severely bruised the elbow-joint, and surrounding soft parts. Leeches were employed immediately after he recovered from the shock occasioned by the injury, which, along with fomentations and poultices, afforded great relief; but whenever the bleeding ceased, pain and a feeling of tension returned. More leeches were then applied, and were repeated whenever the bleeding from the preceding wounds ceased, and the pain returned; so that in four days preceding one hundred and eighteen leeches were applied. In this manner, and on this principle, have I, by the repeated application of leeches, kept up a constant oozing of blood from injured parts, until every inflammatory symptom has been completely checked and subdued.

When this system of treatment is not employed early, almost immediately after the effects of the shock have passed away, and time is given to the inflammatory symptoms and a febrile disturbance of the system to supervene, then the treatment must commence with general bleeding, conducted on the principles which I shall afterwards endeavour to point out.

Local bleeding, when employed, even when there has not been any unnecessary delay, after the infliction of an injury, is not always sufficient to prevent the accession of febrile symptoms, especially when the injury has been severe, and the injured parts have an important function to perform. Hence it is a useful practical rule to follow, that, whenever in any case of injury, local bleeding is not sufficient to check the accession of fever, general blood-letting ought to be unhesitatingly adopted.

If, besides a bruise, the soft parts are wounded, the subsequent hæmorrhage often goes far in checking the approach of inflammation; and hence, when recent wounds have bled freely, and when they have not been subsequently irritated by dressings and bandages, inflammatory symptoms seldom ensue, nor does any local or general blood-letting become necessary.

Leeches, cupping, and scarification, it has been already mentioned, are the different methods of local bleeding, and each of these modes of abstracting blood has both its advantages and disadvantages, and is applicable to particular states of disease.

Leeches are found to be by far the most eligible mode of local blood-letting in the generality of cases; not only because they procure the necessary quantity of blood from the parts where the application of cupping-glasses would cause great pain and irritation, but also because, from the great dexterity required to perform the operation of cupping, it is seldom well done, and cannot be commanded in situations and at times when leeches can easily be procured.

In the application of leeches, it is important to be aware that the bleeding from their wounds is never in the ratio of the number applied; and it is surprising to find three or four leeches bleed as much on one occasion, as at least double the number on another. Usually, when many are applied, the blood flows most freely from a limited number of the wounds, and these continue to bleed long after the bites of the others have ceased. This probably depends on the principal vessels supplying the part on which the leeches are applied being wounded, and those wounds which happen to be made nearest the heart bleeding more than those in the more remote branches. The bleeding, too, from leeches varies much in quantity, not only according to the state of the circulating system generally, but also according to the degree of inflammation or congestion in the part where they are applied. The difference in the bleeding from the same number of leeches on the same part at different times, is very remarkable; the quantity diminishing as the fulness of the vessels is diminished.

Leeches bleed very differently at different seasons and in different states of the atmosphere. We should also bear in mind, when comparing the effects of cupping and leeches, that advantages are derived from the long-continued fomentation of the affected parts to which the leeches have been applied, as well as from the soothing influence of a poultice, which ought always to be used after the fomentations.

One disadvantage of the use of leeches is the difficulty of always regulating the extent of the bleeding; but I have already observed, that the discharge from their bites usually depends on the degree of congestion of the vessels of the part to which they are applied, and that they seldom bleed more than is requisite. When it becomes desirable to put a stop to the bleeding, this can in most cases be readily effected by simply exposing the surface of the part to the external air, and allowing the blood in the orifices to coagulate. The usual practice of applying compresses and bandages, and heaping them on in proportion to the activity of the bleeding, tends to promote, instead of checking the flow of blood.

Early one morning I was sent for to visit a lady who had violently sprained her wrist on the preceding day, and for which she had applied leeches. They had bled freely all the evening, and so profusely during the night, that a variety of styptics, compresses, and bandages were used, but without arresting the hæmorrhage. The patient being alarmed, it was expedient to arrest the bleeding, and scarcely had the bandages and compresses been removed, all of which were soaked in blood, and the hand and arm exposed to the cool air, than the flow of blood began to diminish, and in a few minutes was completely stopped.

When this simple means is not sufficient, the bleeding from a leech-bite can usually be stopped by applying a small compress not larger than a finger-nail, and consisting of several folds of lint, directly upon the bleeding orifice, on which such a degree of pressure is to be made with the point of only one finger as shall be found sufficient to stop the bleeding, and this pressure is to be steadily continued until all tendency to bleeding has completely ceased. I have never known this practice to fail, except in a few cases where the hæmorrhage arose from the blood wanting its usual coagulating power, and in some children where from the leeches having been applied to the neck, and where the leeches were of a large size, the necessary degree of pressure could not be employed. In the first class of cases applying vinegar to the wound, or touching the orifice with the nitrate of silver produces an immediate coagulation of the blood, with which it mixes, and thus plugs up the wound. This caustic may be in like manner employed in hæmorrhages from leech-bites in children; and Sir Charles Bell has, in troublesome cases of this kind, stitched the lips of the wound together with a fine needle and thread, or the needle may be allowed to remain for some hours in the wound, and its thread twisted round it, as is done in making the twisted suture, and thus a firm and unyielding compress is formed upon the wound.

When leeches cannot be procured, the requisite quantity of blood may be obtained by opening with a lancet one or more of the veins contiguous to the injured parts; and this mode of blood-letting is particularly applicable in injuries of the extremities, where there are so many veins accessible and sufficiently large. The advantages of applying leeches, which have been enumerated, are also to be derived from this method, in all local affections where the parts from which the blood is to be withdrawn are tender to the touch, and any other mode of local blood-letting is inadmissible.

Cupping.—In all cases of local inflammation where the general system is not disturbed, leeches are preferable to venesection, whilst the operation of cupping holds as it were a middle place, being applicable not only in cases of local inflammations and congestions, where there are no febrile symptoms, and where leeches might be employed, but also in cases where the action of the vascular system is increased. In all inflammations and congestions about the head, cupping on the back of the neck, and between the shoulders, is a most useful mode of abstracting blood, and this operation is also particularly applicable for the removal of blood from the parietes of the chest and abdomen in diseases of the different viscera. Its use, however, is only admissible when it can be employed without exciting pain, and irritating the diseased organ. In such cases I have often seen cupping do mischief. For the same reasons cupping inflamed joints, or parts, where much external tenderness is present, is often injurious, so that in such cases leeches are decidedly preferable. Cupping is also preferable in those cases where the application of leeches is followed by severe erysipelas of the skin. The very circumstance of the cupping-glasses irritating the tender parts, and drawing blood from the surrounding parts to the place where they are are applied, renders it an eligible mode of abstracting blood in cases of congestion, more particularly of the brain, the glasses being applied to the nape of the neck, whilst cupping is the least preferable mode of abstracting blood when the application of the glasses excites pain, and the influx of blood to the diseased part is increased. Although, therefore, cupping may be, under many circumstances, preferred, yet it cannot be denied that there are no cases where cupping can be advantageous, in which all the essential utility of abstracting blood by that operation might not be obtained either by venesection, or by leeches, or by a combination of both of those methods. I have often remarked, that in this metropolis, where there are so many dexterous performers of this operation, persons, more particularly those subject to plethora in the head, are apt to indulge in a luxurious system of living, the evil effects of which they can at all times have readily removed by cupping.

Scarification.—There is no class of diseases where the effects of the local abstraction of blood are so well exemplified as in some inflammations of the eye, in which a quantity of blood may be taken from the conjunctiva by the operation of scarification. The beneficial effects of applying leeches at the orifices of the different mucous canals, when depletion is required, is well established, and the operation of scarifying the conjunctiva, lancing the gums, puncturing hæmorrhoidal tumours, and making incisions in inflamed parts, all give relief on the same principle.

GENERAL BLOOD-LETTING.

Having endeavoured to point out the different modes by which blood may be abstracted *locally*, and illustrated the salutary effects of local depletion by references to the phenomena of spontaneous hæmorrhages, various local inflammatory affections, as well as congestions of blood, we now come to consider the subject of *general* blood-letting, the indications which point out the propriety of employing it, and the quantity of blood to be removed in the treatment of various diseases.

It was remarked that whenever any local disease or injury has excited a febrile disturbance throughout the system, general bleeding ought then to be decidedly preferred to local bleeding, and the indications to which our attention ought more especially to be directed in deciding on the propriety of general blood-letting, are, the state of the heart and arteries, and the character of the local pain.

The leading symptom by which the constitutional disturbance demanding venesection is indicated, will be found in the quality of the *radial pulse ;* and in deciding on the propriety of general blood-letting, it is not always necessary that the pulse should be frequent, or tense, or full, or hard, but on all occasions to be satisfied of the propriety of abstracting blood from a vein, whenever, in any complaint of an inflammatory type, or under circumstances such as those after operations, or accidents, there is the least deviation in the pulse from the natural state. No sooner have a few ounces of blood been abstracted under such circumstances, than the pulse will be observed to "rise," as it is called, and to acquire volume and power, thus confirming the propriety of the measure.

There is nothing more uncertain than trusting to the qualities of the radial pulse, which are usually described as those which alone indicate the propriety of blood-letting, and we ought ever to be aware of the important fact, that, during an attack of inflammation, the pulse varies according to the organ affected, and is even different in inflammatory affections of different textures of the same organ, except in one particular character which shall be presently pointed out.

The mere difference in the frequency of the pulse is a circumstance of little importance in estimating the propriety of general blood-letting, compared with certain changes in its qualities, and, therefore, the usual practice of merely counting the number of pulsations, is apt to lead to the formation of an erroneous opinion. In two patients, in each of whom the pulse beats 120 in a minute, the one may require to be plentifully bled, and the other to have cordials!

Little difficulty occurs in distinguishing those states of the system which require general bleeding when diseases have made considerable progress, and when their symptoms and character have become distinctly developed. It is before they arrive at this period, and that too when medical treatment is most available, that their true nature is apt to escape detection, and there are many states of disease where substantial advantage is to be derived from venesection, and where, at the same time, it could not be affirmed, from the presence of any particular symptom, that inflammation did actually exist. " Inflammation in some textures of the body," observes an intelligent writer, " is so obscure in the beginning, so insidious in its progress, and so rapid in its termination, that in all cases in which the surgeon hesitates respecting the necessity of bleeding, it is a wise plan not to deprive the patient of the benefit of the doubt, but immediately to proceed to venesection."

It is also certain that there is a period of disease, when bleeding is not only unnecessary but improper ; and there is one moment when venesection may be had recourse to with more advantage than at any other. To detect this precise period must, therefore, be of great practical importance. In those who have been wounded, or who have met with some severe accident, or on whom an operation has been performed,—in all such cases the action of the heart and arteries, which is at first diminished by the general shock, should be allowed to recover, or reaction should take place before resorting to blood-letting,—and this rule applies generally to all inflammatory diseases. The chill, for instance, which a person receives from sudden exposure to a change of temperature, and which lays the foundation of an inflammation in some of the internal viscera, produces a collapse of the whole frame, which is not followed until after a certain period, by those inflammatory symptoms which require blood-letting.

The incompressible pulse.—The peculiar feeling in the radial pulse to which I have alluded, and which points out, almost universally, the propriety of general blood-letting, is sufficiently well indicated, by the term " incompressibility." An incompressible state of the pulse may, I venture to say, be considered as pathognomonic of inflammation, in whatever organ or texture that inflammation exist. I have already remarked, that each of the different textures of an organ when inflamed, is attended with some peculiarity of the pulse. Inflammation of the dura mater,—of the cerebral pulp, —of the pleura,—of the mucous membrane of the bronchi,—of the pericardium,—of the muscular parietes of the heart,—of the serous membrance which lines its cavities,—of the peritoneal and of the mucous coats of the intestinal canal,—are each accompanied by peculiarities of pulse ; but in all we will be able to detect *incompressibility*. For whether the pulse be full or small, hard or soft, frequent or slow, if with the point of one finger the artery be pressed at the wrist, we shall perceive with another finger applied to the artery beyond the first finger, that unless a very considerable degree of pressure be employed, the pulsation of the radial artery will not be entirely destroyed, but the sensation, as if of a fine thread, or hair, will remain.

Attention to this quality of the radial pulse I may confidently assert, has scarcely ever failed to guide me, in the use of phlebotomy, even in otherwise doubtful circumstances, and a conviction of the accuracy of the observation has led me to employ bleeding in many cases, where I could not otherwise have ventured to have recourse to this remedy, from the absence of the ordinary indications of inflammatory action.

It was this state of pulse which first pointed out to me the propriety of employing venesection in erysipelas, in cases of sloughing ulcers, in exanthematous fevers, in cases of poisoned wounds, in specific diseases, and in certain stages of several other affections to be afterwards considered, and where an opposite system of treatment is frequently, nay usually, followed. In most of the diseases now alluded to, by a superficial examination of the pulse, an impression is generally received that there is a feeble state of the circulation, and hence, in place of a depletive or antiphlogistic mode of treatment, wine, bark, and stimulating remedies, have been employed.

Varieties of the Pulse.—Though in no case have I observed an incompressible state of the pulse, without finding venesection to be an expedient measure, yet there are other qualities perceptible in the radial pulse which also indicate the propriety of blood-letting. A hard pulse, a firm pulse, a full pulse, a wiry pulse, an oppressed pulse, all, either taken singly or combined with other symptoms, more particularly local pain, hot skin, and white tongue, point out the propriety of employing general blood-letting.

No acquirement demands more attention and experience than that which enables us to distinguish the various peculiarities of the pulse, both in health and disease. This knowledge entirely depends on the exercise and acuteness in the sense of touch. Like that of sight and hearing, the sense of touch differs exceedingly in its acuteness in different persons, but in all it is capable of great improvement. We cannot expect to be at first able to distinguish the nicer shades of difference in pulses which are palpable to an experienced finger, any more than we could expect at once to be able to perceive the slighter varieties in the shades of colours so easily discernible by a skilful painter. All the senses require tuition. We ought to practise, and feel a number of different pulses, both of people in health, and of those afflicted with disease, one after another, and by first observing strong contrasts, we shall ultimately become familiar with their lesser differences, all of which essentially assist in pointing out particular states of the vascular system.

We shall thus learn that there is a great variety in the pulse of different persons in health,—in the number of beats at the different periods of life, and at different hours of the day, and that there is frequently a difference in the pulse of the two arms of the same person,—and, moreover, that the pulsations of the heart and arteries do not always correspond. The pulse, too, is usually found more frequent in women than in men, and in the morning it is slower than in the latter part of the day, its quickness being increased by various bodily and mental stimuli. To all these differences our attention ought to be directed as points of great practical utility.

The Cardiac Pulse.—The pulsations of the arteries, and those of the heart, will be often found not to correspond. I do not allude to the number of the pulsations, but to their strength and other qualities. Indeed it may be stated generally, that where the pulse at the wrist is contracted and difficult to compress, the heart will be found to beat with an increased degree of vigour. Hence an increased impulse of the heart may be regarded as a useful guide in the employment of blood-letting, and when taken into account with the incompressible state of the radial pulse, will afford additional confidence in deciding upon a depletive system of treatment.

A knowledge of the heart's impulse, or the cardiac pulse, can only be acquired, like that of the radial pulse, by frequent examination and we ought carefully to cultivate the opportunities of making ourselves equally familiar with the peculiar changes in the actions of the heart as with those of the pulse.

The Local Pain.—In almost every case where general blood-letting is necessary, besides the altered action of the vascular system, we have also, more or less, local pain. But the degree of pain, whatever organ the inflammation may affect, cannot be considered as a measure of the violence of the accompanying inflammation. On the contrary, persons often suffer severe agony when there is but slight inflammatory action; whereas, when the inflammation has arrived at its acmé, the local pain becomes dull and obtuse, and diminishes in intensity.

Whilst it is always expedient to have recourse to blood-letting, if there is a fixed and unceasing pain, increased by pressure, and accompanied by an alteration in the radial and cardiac pulse, it is of great importance to be aware, that though the local pain is usually alleviated, as well as the action of the vascular system subdued, by venesection, yet general bleeding must not be continued, nor repeated, as long as the local pain remains. On the contrary, when all febrile excitement has been subdued by bleeding, any pain may be then alleviated by opiates, either taken singly, or combined with calomel or antimony, local bleeding with leeches may be necessary, or the pain may yield to a blister or a sinapism. Where local bleeding is employed, the degree of pain is the chief indication, both for adopting it, and for regulating its extent and repetition.

Importance of the First Blood-letting.—There is no maxim of the practical importance of which I am more fully convinced than that the loss of a certain quantity of blood at the first bleeding, is of greater utility in stopping the progress of disease, where general bleeding is required, than the loss even of a much larger quantity of blood by several successive bleedings; that is, in place of taking a quantity of blood, say sixty ounces, at three successive bleedings of twenty ounces each, performed within thirty-six hours, an infinitely greater degree of relief will be derived from taking two-thirds of that quantity at one bleeding. As thus not only will the progress of the disease be more quickly and decidedly checked, but the patient will be saved the loss of twenty ounces of blood.

The good effect of abstracting so large a quantity of blood at the first bleeding, is nothing more than might have been expected, as we know by experience that one great benefit of depletion is derived from the sudden change which it produces on the action of the heart and arteries, and it is evident that such change must be effected in a more decided manner by abstracting a large quantity of blood suddenly, and at one bleeding, than by taking away an equal quantity slowly, and at intervals.

Unfortunately, in cases where bleeding is employed, there is too often a disposition to be sparing in the evacuation; whereas in the generality of cases an effort ought to be made rather to take away as much as the patient can bear, and not to desist until there be rational grounds to expect that a second bleeding will not be necessary.

A good general rule for estimating the quantity of blood to be taken, will be found in the change produced by the venesection on the action of the heart and arteries. Nor is the diminution of the local pain, whilst the blood is flowing from a vein, to be entirely disregarded. But the only unerring guide, as far as I have been ever able to discriminate, is the change produced in the *pulse*. This change is indicated by the cessation of its "incompressibility," but it is rarely produced until fainting or syncope occurs. The pulse ought to be carefully watched after the fainting goes off, when it will be sometimes found that the sensation of incompressibility soon returns. If this takes place, more blood ought immediately to be allowed to flow until the feeling of incompressibility is entirely subdued[1].

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[1] A young athletic officer complained of an intense pain in the head, accompanied with such depression, that he could with difficulty stand out of bed. His pulse, though not much altered, was incompressible. Upwards of forty ounces of blood were abstracted before syncope came on. When I visited him two hours

When a large quantity of blood is not taken away at the first bleeding, or at a second quickly succeeding it, I have generally found that on all future occasions it is seldom practicable to abstract any very considerable quantity, however much it may appear necessary.

Causes of Failure in Venesection.—It has been hitherto taken for granted that the surgeon has it always in his power to abstract whatever quantity he may deem necessary. This, however, is not the case, or at least the requisite quantity of blood is not always obtained without some difficulty ; and nothing is more common than to hear of patients suffering from not having lost a sufficient quantity of blood, and affirming that it was impossible to bleed to the desired extent.

This is a dangerous maxim, and I have ever contended that any quantity of blood deemed necessary, can, by some means or other, be obtained in every case. Should the veins in the arm be inadequate for this purpose, then phlebotomy may be performed on the jugular veins, or veins of the wrist or feet ; and in cases of danger, when no time ought to be lost, why should not an arterial trunk be opened? The most severe operations are daily resorted to, to save life, and surely a fellow-creature should not be allowed to die for want of the loss of a quantity of blood! In the *Transactions of the Med. and Chir. Society*, there is a case narrated wherein the necessary quantity of blood could not be obtained from the veins of the arm, and where the bold and decided practice of opening the radial artery was successfully adopted.

It ought also to be remembered that when neither venesection nor arteriotomy can be performed, a large quantity of blood may be abstracted by leeches or cupping. The French are in the habit of applying at one time from fifty to a hundred leeches in cases where we would employ venesection.

Effect of Syncope.—It has been laid down as a general rule in the treatment of many inflammatory diseases, that blood should be abstracted until syncope is produced ; by which one would be led to suppose that the fainting was either a certain token of the quantity of blood that should be taken away, or that it was the act of syncope itself, and not the loss of the blood, which was to cure the disease. Hence we often hear of persons who were bled till they fainted, as a proof of the activity of the practice which had been employed, without considering whether the fainting had been produced by excessive depletion, or had arisen from the particular position of the patient whilst the operation was performed. Suppose that two individuals are similarly affected, and in every respect in the same state, one of whom is bled in the erect posture until he faints, while the other faints from the loss of blood whilst he is recumbent. In the first patient the syncope will probably be produced by losing one-half of the quantity necessary to be lost before the second patient falls into a state of syncope.

It is, therefore, important to consider whether the purpose of the operation be to abstract a certain quantity of blood from the system, or merely to produce a temporary state of syncope. When it is desirable to make a person faint with the loss of as little blood as possible, as, for instance, in a case where we wish to reduce a strangulated hernia, or a dislocated bone, then the venesection ought to be performed in the sitting posture. But for the treatment of diseases requiring the abstraction of a certain quantity of blood from the system, fainting ought not to be considered as an index of the quantity to be withdrawn, but the usual means should be taken to avert its occurrence, except when the patient is in a recumbent posture at the time the venesection is performed. Indeed we ought to be particularly cautious in treating inflammatory diseases not to presume that because the patient has been bled to *deliquium*, that therefore the bleeding has been carried to its full and necessary extent. On the contrary, when, in any case, syncope has followed the abstraction of an unusually small quantity of blood, while the patient was in a recumbent position, then, in the space of one or two hours, the patient should be again examined, when probably we shall find that the action of the vascular system has renewed its vigour, and the inflammatory symptoms continue. If blood be then allowed to flow from the vein, a very copious bleeding will sometimes be found requisite to reduce the pulse.

This premature state of syncope, as it may be considered, may not only arise from the patient's being bled in the erect posture, but is sometimes the effect of moral impressions, and, therefore, when, under such circumstances, the fainting state has gone off, the inflammatory symptoms soon reappear[1].

Syncope ; how beneficial.—The state of syncope, which I have endeavoured to point out as an unerring criterion for estimating the extent to which blood should be removed, in those cases where general bleeding is most expedient, is, by most practitioners, taken as their guide ; and though some have argued that a state of syncope thus brought on may be pernicious, and even dangerous, I have

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afterwards he had recovered from the state of fainting, and there was a degree of incompressibility of the pulse still existing. The bandage was reapplied on the arm, and upwards of twenty ounces more blood were abstracted before the fainting state returned. These bleedings were followed by a complete relief of the pain in the head, and along with the free use of purgatives, calomel, and antimony, he permanently recovered.

[1] *Case.*—A gentleman was seized with severe pains in the bowels, with a good deal of tenderness on slight pressure, and accompanied with febrile excitement. On opening a vein in the arm, only a few ounces of blood were lost, when the pulse sunk and he fainted. Two hours afterwards, having recovered from the state of fainting, and not having experienced any relief, the bandage was again applied on his arm. Blood flowed freely from the wounded vein, and he did not fall into a state of syncope, until he had lost about thirty ounces of blood ; and this, along with purgatives, was followed with permanent relief.

never, met with a case where general bleeding, judiciously resorted to, caused any serious mischief from its being carried so far as to produce syncope. In considering this point we ought of course to discriminate between those cases where the bleeding has been employed as a curative means, and those wherein a profuse hæmorrhage has taken place from wounded vessels, as from accidents, or from a partial separation of the placenta. Under such circumstances the bleeding may not only produce syncope, but such may be the size of the bleeding vessels, that the blood will continue to flow until life is nearly or even completely extinguished. But in the operation of phlebotomy the flow of blood can and ought to be arrested whenever syncope takes place; no one surely ever attempted to persevere in abstracting blood from a patient in this state. On the other hand, the fainting is to be considered as an index of the quantity of blood necessary to be removed for the relief from the disease; and, as I have already said, it will always be found that the quantity is in the ratio of the propriety and necessity of the depletion.

Though it has been stated that in no case of syncope from venesection have I ever witnessed any pernicious effects, yet in some cases it has been carried to the very last extremity, and the consecutive symptoms have caused great alarm to the bystanders as well as to the operator. Such cases, however, must be very rare, for accustomed as we are to hear daily of persons being bled to a great extent, yet such alarming effects are seldom heard of; though many hundreds, or even thousands, of persons in this community are bled every day.

I have observed persons recover from inflammatory affections, whose vital powers appeared so reduced as to render their state apparently hopeless, this low condition seeming to be the very means of arresting the diseased action.

Blood-letting, when to be repeated.—Though, in the generality of cases much depends on the full quantity of blood being taken at the first bleeding, as well as having recourse to blood-letting in the early stages of disease, still there are other cases wherein the complaint can only be cured by the frequent repetition of venesection; and this is rendered necessary from different causes, as for instance when a fainting state comes on after only a small quantity of blood has been abstracted, or where the pulse sinks after a very moderate quantity has been removed.

But when, from whatever cause, the quantity of blood abstracted has been small, it ought to lead to the more close watching of any return of the symptoms, and prepare the surgeon to repeat the bleeding.

Now it frequently happens, that on the repetition of the venesection, the cause which prevented the first depletion being sufficiently copious, no longer exists, so that at the next bleeding any quantity of blood which may be deemed necessary, can be readily abstracted.

But the most frequent cause for repeating venesection is, that to whatever extent the first bleeding may have been carried, it is seldom that one depletion is sufficient to check the progress of a severe attack of inflammation, particularly in an important and vital organ.

The more complete the syncope has been from the bleeding, and the sooner the second bleeding is performed after the pulse has begun to rise, the less will be the quantity of blood necessary to be taken away at the second bleeding, as well as the aggregate quantity for the complete cure of the disease. After the first bleeding, therefore, the pulse ought to be closely watched, due attention being also paid to the other symptoms; and whenever the vascular system has begun to recover its vigour, which may take place in three, six, or twelve hours, then replace the bandage on the arm, wipe away the coagulum in the wound of the vein, and allow the blood to flow, until the strength of the heart and arteries is again subdued. Whenever there is a probability of its being necessary to repeat blood-letting, the pain, and even sometimes the difficulty of making a new incision may be avoided, by simply anointing the lips of the wound, which will prevent their agglutination.

Conditions of the Blood.—There are appearances which blood presents, both whilst it flows from the vein, and after it has been kept some time and allowed to coagulate, which have been considered as affording criteria for regulating the quantity of blood to be withdrawn, and for the repetition of the venesection.

In violent inflammations, the blood usually flows from the wound in the vein with great force; whereas in other diseases the stream is comparatively slow. In the first case the bleeding ought to be as profuse, as in the latter it should be limited. The colour of the blood as it flows from the vein, also varies in different examples of disease, being in some very florid, or of a scarlet red, and in others of a crimson red or deep purple colour. The first state of the blood indicates the propriety of copious blood-letting, whilst the latter points out a state of the system where but a very moderate depletion is admissible.

The appearances which blood assumes after it has been allowed to stagnate, are also supposed to afford indications for the repetition of venesection. The buffy coat, and the comparative quantities of crassamentum and serum have especially been considered as an index of the existence of inflammation, and of the propriety of blood-letting.

These circumstances, however, can never be a criterion for estimating the quantity of blood proper to be removed, whilst the blood is flowing from the vein, neither can any appearance of the blood after its coagulation, be a guide for repeating the venesection. The appearance of the buffy coat has been chiefly dwelt on as an important character of the inflammatory diathesis; but it is not to be considered either as a certain test of inflammation, or a safe index of the propriety of bleeding. There is usually no appearance of the buffy coat in blood removed from persons affected with even the most violent inflammations until the latter stage of the disease, and at the very time when the further abstraction of blood would be pernicious. On the other hand, the buffy coat may be frequently observed, in many diseases where blood-letting is unnecessary, or even hurtful.

Quantity of Blood to be abstracted.—It is not unusual for medical men to give instructions to take a certain quantity of blood from a patient, with the same degree of confidence as they would prescribe a specific dose of some drug. Nothing can be more absurd in principle, and more injurious to the sick. The only indication to direct us in measuring the quantity of blood which ought to be abstracted in individual cases, is the change produced on the pulse, and on the local pain during the operation. We ought never, therefore, to hazard any preconceived opinion of the quantity of blood which it may be necessary to remove in any case, but always to watch the effects of the evacuation. It often happens, that a pulse in which little deviation from the natural state can be detected, and which, considered singly, would not particularly indicate the necessity of bleeding, begins to rise, and to acquire force after a certain quantity of blood has been lost, and its force is not subdued until a large quantity, often much greater than could have been anticipated, is removed. On the other hand, we frequently meet with cases, where the very reverse happens, and where a person, apparently of a full habit, with a strong elastic pulse, becomes quite depressed after losing but a very small quantity.

It is singular how small a quantity of blood some persons can lose; even the very impression on the mind that blood is to be abstracted causes sickness, and fainting comes on after a few ounces only of blood have been removed. In such cases, however small the quantity be which is evacuated, there is often a decided relief, the syncope causing even a permanent subsidence of the inflammatory symptoms.

No one therefore should pretend to specify the precise quantity of blood which any patient ought to lose; and the practitioner considers but little the well-being of the sick, when, instead of performing the operation himself or being present to observe its effects, he ventures to prescribe the loss of any particular quantity of blood! Such conduct is highly derogatory to the character of the profession, and calls for the severest animadversion. Another pernicious effect of this loose way of prescribing so important a remedy may be instanced in cases where physicians have allowed their patients to remain several hours in a fit of apoplexy, or in a state of great suffering, rather than themselves perform the operation of venesection; it is surprising that the legislature should not have interfered, and indicted the culpable parties,—just as the law punishes those whose want of professional skill is the cause of injury to persons who are placed under their care.

In forming an opinion of the probable extent to which bleeding should be carried in different instances, we ought to be aware that, in general, fat people can with impunity lose much less blood than lean persons, and large and robust individuals do not require the same extent of depletion in inflammatory diseases, as those who are thin and appear to be more delicate. So it is with respect to age, the young and plethoric often bear much less bleeding than the old and thin.

To prevent, therefore, the practitioner being guided by any preconceived notions on this point, the blood should always be made to flow into a large basin, and no other circumstance should be allowed to influence the judgment in estimating the quantity to be removed, than the abatement of the local pain, and the changes in the action of the cardiac and radial pulse, to which I have already alluded.

When employing venesection, and observing the indications which have already been pointed out in order to regulate its extent, it will be generally found that the quantity of blood which we are able to remove before fainting comes on, is, in fact, never more than is requisite for the cure of the disease. A person in health usually faints from the loss of a comparatively small quantity of blood, whilst the same individual requires, after suffering but a few hours from active inflammation, to lose an almost incredible quantity, before he falls into a state of syncope. At every succeeding operation, fainting comes on from the loss of a smaller and still smaller quantity.

Hence the difficulty of attempting to give any thing like a precise idea of the quantity of blood which patients require to lose in the treatment of particular diseases. It would be no less absurd to attempt to specify the quantity of purgatives or diaphoretics necessary to complete the cure of a fever!

COPIOUS HÆMORRHAGE NOT INJURIOUS.

From a general impression that blood-letting ought not to be employed but in diseases of a serious character, and that it is a remedy from which much mischief may ensue, if carried to too great an extent, or employed in improper cases, it is no doubt, on many occasions, too tardily and too sparingly resorted to, whilst we every day see medicines, the effects of which may be highly injurious, fearlessly and carelessly exhibited. This dread of blood-letting is not founded on sound observation.

Alarming hæmorrhages sometimes ensue during, or after, operations; and it is important to remark, that those patients recover more quickly, and have much less fever, in whom such a large quantity of blood has been lost.

In the spontaneous hæmorrhages from mucous membranes, as from those of the nose, bronchi, and rectum, it is extraordinary what large quantities of blood persons will sometimes lose with no other sensible effect, than more or less debility[1].

The quantity of blood which some persons lose from hæmorrhoids is also extraordinary. I have known instances of delicate females losing daily, on an average, from half a pint to a pint of blood for many months, and even years,—a quantity which, when compared with the largest quantities of blood ever removed by artificial means, appears astonishing; and the slight disturbance of the system, which such profuse hæmorrhage occasions, seems indeed unaccountable.

Similar effects of the loss of large quantities of blood are exemplified in cases of varicose veins accidentally ruptured, and from which immense quantities of blood have escaped, without any perceptible injurious consequences. Petit particularly mentions such cases.

Hæmorrhage to an enormous extent sometimes happens on the field of battle, wounded soldiers being often found apparently lifeless, yet they recover from their wounds with unusual rapidity, by the complete check which is thus given to consecutive inflammation.

In the partial separation of the placenta the loss of blood is sometimes excessive, yet women often recover, without any other bad effect than temporary debility.

These facts, taken collectively, prove to what an extent blood may be lost, without being followed by serious consequences.

CURATIVE EFFECTS OF BLOOD-LETTING.

Having endeavoured to explain most of the important circumstances connected with the subject of blood-letting, I propose to make some general observations on its curative effects, glancing over those various classes of diseases to which our attention ought to be particularly directed in the employment of this important remedy. We shall also add some remarks on the advantages which are to be obtained by blood-letting in some diseases in which it has not been usually employed. These, however, I shall only notice briefly, as the general principles already pointed out render any detailed account of the practice in particular diseases unnecessary.

Though it may be said that there is scarcely any disease in which bleeding has not been employed as a remedial means, yet there are several diseases, as well as several stages or periods of disease, where it has not generally been adopted, from some preconceived theory, or an incorrect knowledge of their pathology, or perhaps from the supposed absence of certain states of the pulse, which had been considered as the necessary indications for adopting it.

In Febrile Diseases. — Blood-letting must be considered a most powerful remedy, whether we contemplate its effects in the treatment of " fevers" properly so called, in the " phlegmasiæ," where there is an inflammation of some particular organ, or in the exanthematous or eruptive fevers. Much controversy, however, has arisen as to its propriety in the treatment of fever, chiefly from the observations of different writers not having been made under the same circumstances, no class of diseases assuming a greater variety of type, not only in different countries and in different classes of the community, but even in different years and seasons in the same place and in different individuals of the same family. The fever which at one period, and in one class of persons, is mild, may, in a short time, and in some other persons, assume the greatest severity; whilst that which at another period appears in a severe and inflammatory form, demanding most energetic depletion, may, at no very distant period, commence with typhoid symptoms, and require a perfectly opposite system of treatment In the treatment of this class of diseases, therefore, all that can be done is to establish such general principles as shall be applicable to the different forms or types in which the fever may present itself.

The objections to the use of blood-letting in fever were grounded on the erroneous notion that the disease had a certain course to run which could not be shortened, and hence the necessity of husbanding instead of exhausting the resources of the system.

Eruptive Fevers.—It is not many years since blood-letting was first employed in the treatment of exanthematous diseases, from an impression that they also had to " run their course," and that the great exhaustion necessarily created by the disease, required all the resources and powers of the system. Numerous facts have proved the utter groundlessness of such a doctrine. There is no febrile disease, even of a specific character, such as small-pox, measles, or scarlet-fever, wherein blood-letting may not be advantageously employed under certain circumstances conjoined with other remedies, particularly during the early stages of these maladies: even in syphilis and gout, besides the specific inflammation which forms the essential character of the malady, there are often symptoms of another kind which arise from the presence of an idiopathic or common inflammation, and which are to be subdued by blood-letting. This observation applies also to the phenomena of eruptive fevers.

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[1] *Case.*—A man was admitted into the hospital of surgery with dropsy, which he expected would be relieved by tapping. A few hours after his admission, he was seized with bleeding from the nose, and although his pulse was feeble and his skin cold, having already lost not less than two quarts of blood, I bled him at the arm, and the bleeding from the nose then ceased. But the particular circumstance in this case was, that notwithstanding the great loss of blood he had sustained, his pulse on the following day became firm and wiry, and was accompanied by pain in the abdomen; he was therefore again bled at the arm. On the second day the pulse rose, and he was bled a third time, after which he was tapped, and got a large dose of calomel and opium. This treatment had the effect of completely mitigating his sufferings. Calomel and squills were then given, until his gums became tender. He left the hospital fourteen days after his admission completely relieved, and a few weeks afterwards I saw him in perfect health.

In Scarlet Fever.—Blood-letting may be resorted to in the early stages, especially when there is a determination of blood to any particular part, as the chest and head. Sometimes the inflammation of the throat, the characteristic feature in this disease, is so severe, that much relief is obtained by a local bleeding, more or less profuse ; but when any of the vital organs are affected, then venesection is indicated.

Here too the notion prevails, that in this disease patients cannot endure a depletion, or that it is unnecessary and indeed improper for their treatment. Scarlet fever, it is true, in many cases passes through a very mild course, with scarcely a symptom requiring any particular treatment ; nay, in some cases the pulse, from the very commencement of the disease, is feeble, and the powers of life sink rapidly. But we ought also to be aware, that cases do occur where severe inflammatory symptoms come on, and of that type wherein blood-letting is highly to be recommended.

In Small-pox.—The benefit of blood-letting, when the febrile symptoms are severe, or when inflammation affects any particular organ, is beyond doubt. An intelligent army-surgeon made it a general rule, from which he had experienced the greatest benefit, always to bleed soldiers on the commencement of the fever preceding the eruption.

In Erysipelas,—much benefit is derived from the profuse hæmorrhage which follows incisions made into the inflamed integuments. Such a practice will, however, I am persuaded, be seldom found necessary, if blood-letting be had recourse to in the early stage of that disease.

From a supposed typhoid character of erysipelas, it was the general practice, and is still with some, never to deplete or pursue an antiphlogistic plan of treatment in this disease ; and I well remember visiting a patient who was suffering from a very severe attack in the face, and finding at her bedside a large tumbler of wine and water, and that she was taking as much bark as she could receive. By bleeding her freely, and repeating the operation three successive times at short intervals, along with purging and antimonial medicine, she rapidly recovered ; and the medical attendant who first saw her, expressed his surprise at the treatment I had employed, remarking, that during a long attendance at a public hospital, he had never seen blood-letting employed in erysipelas, and that nearly all the cases he had seen of that disease affecting the face and head had terminated fatally.

In erysipelas there is usually a peculiar feeling in the pulse, which is apt to deter the practitioner from employing blood-letting ; the pulse is small, but more or less incompressible, and whilst the blood is flowing from the vein, it acquires more and more volume, and often a very considerable quantity is abstracted before a fainting state supervenes.

Whenever the abstraction of blood is necessary in the treatment of erysipelas, *general* is to be preferred to *local* blood-letting ; and chiefly for this reason, that the leech-bites often act in such states of the system only as additional local exciting causes, and therefore the local irritation caused by them ought to be avoided, which can be done by adopting venesection. Besides, we seldom see erysipelas so severe as to require blood-letting, without more or less disturbance of the whole system, and this is a further reason for preferring general to local depletion in the treatment of this disease.

In Acute Inflammation.—Whenever there is any organ under the influence of inflammation, and febrile excitement is also present, the abstraction of blood should be unhesitatingly employed. The blood should be taken from the arm whilst the patient is in the recumbent position, until syncope is produced, and the operation repeated whenever the pulse rises, and until the febrile symptoms are subdued. Local determination to any particular organ may afterwards be combated by local depletion. It is always of importance, in the treatment of inflammation, that the general should precede the local bleeding.

In Chronic Inflammation.—When inflammation assumes a chronic, or subacute form, the abstraction of blood is an equally useful remedy as when inflammation is in its acute stage : the above terms have each been employed to denote the state of an inflamed part wherein there is no longer any febrile excitement, no disturbance in the action of the heart, but where there is a change merely in the condition of the capillary system. Local is usually preferable to general blood-letting, to subdue inflammation in this stage.

In cases of chronic inflammations, I have been in the habit of recommending the frequent repetition of small bleedings in place of one or more large depletions. A person afflicted with some chronic inflammation, and whose strength would be impaired by any thing like a severe depletion, will often gain vigour and health whilst two or three leeches are daily applied to the diseased part[1].

Ophthalmia also presents itself in numerous forms, wherein this system of small but frequently repeated local depletions are very beneficial; and I might quote numerous cases to show how inflammations of the eye, that have existed long, and for which a variety of local as well as general remedies had been employed without success, were completely subdued by omitting all local applications, and merely applying daily one or two leeches behind the ears alternately, and as long as the symptoms continued to yield to the treatment[1].

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[1] *Case.*—A girl of feeble constitution had a gland in the neck enlarge suddenly. It was tender to the touch, but she had no febrile symptoms. I advised her to apply leeches daily, beginning with four and diminishing the number as the swelling abated, which treatment, along with fomentations and poultices, greatly relieved her, and the swelling gradually diminished. But the leeches were employed no less than seventeen times on this as well as on another enlarged gland before all tenderness went off; and much surprise was expressed, that at the termination of this treatment her general health and strength had improved, and she had regained flesh.

Case.—A girl about six years of age had a scrofulous affection of the second joint of the thumb. A considerable enlargement having taken place of the soft parts, with slight discoloration and tenderness, two leeches were daily applied for one week, one leech every day during the subsequent week, and one every second or third day afterwards, until the swelling completely vanished; and after this treatment her general health was greatly improved.

There are many other organs, particularly the mamma and those of the genito-urinary system of both sexes, liable to those chronic inflammations, all which may be subdued by this system of small but frequent local depletions.

In Congestion.—The observations I have hitherto made on the curative effects of blood-letting, apply chiefly to the treatment of diseases of an inflammatory character. But there is another class of cases in which the propriety and extent of depletion are indicated by a different assemblage of symptoms. I allude to congestion or *plethora* of a particular organ or region of the body, a state very different from inflammation, and which can be artificially produced in the arm by tying a ligature round it, and thus distending the veins. In this state the capillary system, and more particularly the veins of the affected part, are preternaturally distended with blood, but there is no alteration of structure. Congestion ought not however to be confounded with irregular distribution of blood, examples of which we have in flushings of the cheek, in friction on the skin, in the presence of a mote in the eye, and in many of those headachs which are usually called nervous. Bleeding in these cases should not be carried to the same extent as in inflammations, and the blood is to be removed either from the vessels immediately connected with the diseased organ or remote from it. Leeches applied on the frontal vessels, or on the ethmoidal vessels ramified upon the septum of the nose, or applied behind the ears, or cupping the nape of the neck, are the modes best adapted for relieving congestion within the head.

Leeches or cupping may, in like manner. be employed on the parietes of the thorax and abdomen in congestions of the viscera; and leeches on the verge of the anus are particularly beneficial in abdominal congestions, from the connexion which the hæmorrhoidal veins have with the portal system; many diseases of the viscera are essentially benefited by the application of leeches to the feet, vulva, and margin of the anus.

Blood-letting of this kind may often be most successfully employed in restoring the suppressed menstrual flux. For this purpose, the bleeding should be had recourse to the day previous to the approach of that periodical discharge; by thus relieving the system of more or less disturbance, the natural functions are more perfectly performed. In such cases the application of leeches should be to the feet, the vulva, or inside of the thighs.

In *specific diseases*, such as syphilis, cancer, scrofula, gout, and rheumatism, blood-letting is often a useful remedy, when employed within certain limits.

The same observation applies to persons affected with gouty inflammation in any organ. In some cases, a certain extent of depletion will mitigate the inflammatory symptoms attending gout, but if the depletion be carried beyond that, it no longer alleviates the pain; the whole system seems to suffer, and the local disease is apt, as in rheumatism, to assume a chronic and unyielding form.

The inflammation which is caused by a burn or scald may be alleviated by the same plan of treatment[1].

In Suppurated Parts.—It is usually considered that when an inflamed part has advanced to suppuration, the after treatment ought to be altogether directed to the healing of the abscess, for which purpose free incisions are frequently employed. It is true, that usually when the contents of an abscess are discharged, the accompanying pain as well as inflammation abates; but this is not always the case; under such circumstances, local blood-letting is very useful.

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[1] *Case.*—A girl six years of age had the cornea of both eyes so dim that vision was nearly destroyed, and there was a pale redness of the whole sclerotica accompanied by an intolerance of light. She was pale, feeble, and emaciated, the circulation hurried, and the digestive organs considerably disordered. I recommended two leeches to be applied behind one ear every day, one grain of calomel to be given every morning, and after a week, every second morning for a few times. Some of the liquor of potass combined with rhubarb was given twice a day. Such was the manifest benefit derived from the leeches in this patient, that they were daily continued for two months, and afterwards one was applied daily for another month, when the cure was effected.

The result of this treatment was that a perceptible amendment continued to take place daily in her condition. The redness of the eyes gradually subsided, the cornea regained their transparence, the digestive organs improved, and she accumulated health and strength, so that at the end of the third month she required no further treatment, and no local remedy was ever applied to the eyes.

The patient was brought to me upwards of a year after this illness, with a very extensive inflammatory swelling of the soft parts covering one of the tibiæ. I pursued the same system of treatment, and it was not until several weeks had elapsed, and that besides the use of calomel she applied leeches daily, that the swelling was subdued.

[1] A youth about ten years of age, whilst amusing himself with gunpowder, a large quantity ignited, and severely scorched his face. When I saw him a few hours after the accident, I found the whole face much swelled and scorched, and the eyes closed from the swollen state of the eyelids. He had great pain, and the pulse, though not frequent, was firm and unyielding. He was immediately bled in the arm until he became faint, which had the effect of alleviating the pain, and diminishing the swelling. Leeches were applied behind each ear alternately whenever pain returned, and these were repeated morning and evening until the inflammation of the integuments was completely subdued; and whilst this treatment was employed, the bowels were, at the same time, fully evacuated, the patient kept on the antiphlogistic regimen, and the common liniment of lime-water and linseed oil applied to the burn.

In most cases of cellular as well as of glandular inflammation, the purulent fluid which is collected, and forms the abscess, does not make its escape if left to nature until the circumjacent swelling and inflammation have abated. But if the matter has been artificially evacuated, and the surrounding swelling and inflammation have not been subdued, then the application of leeches to the inflamed integuments, once or twice a day, will be most useful; and it will be observed, that whilst the inflammatory symptoms are thus subdued, the suppurative process is, in like proportion, diminished.

When a succession of abscesses has formed in any part, and when sinuses have been extending, as it were, step by step, the inflammation of the surrounding soft parts can be completely checked by local bleeding; and in this manner have I often been able, by the almost daily application of leeches, completely to conquer the inflammation, and thus prevent the formation of new abscesses, and the extension of sinuses.

In Ulcers of the Legs.—Blood-letting is equally applicable to the treatment of the inflamed integuments around an ulcer, and a small number of leeches may be applied with the best effects, in the immediate vicinity of ulcerated surfaces.

In Sloughing Ulcers.—Whenever an ulcer, whether it be the consequence of a wound, or caused by some specific virus, such as that of syphilis, assumes a disposition to slough, it has been usual to employ stimulants, both internally and externally. Now there are many cases of this description wherein an opposite or depletive system of treatment may be advantageously employed; I first observed the extraordinary effect of depletion in a case of sloughing chancre, from which a profuse hæmorrhage took place. A gentleman had lost a great quantity of blood during the night from a sloughing chancre, which had extended into one of the corpora cavernosa. To arrest this hæmorrhage I immediately bled him at the arm till he fainted. The hæmorrhage did not return, but a change took place which I little anticipated, for the sloughing process was completely checked; the slough afterwards separated, and the wound granulated and cicatrised in the most healthy manner.

Cases of this kind furnish proof that sloughing sores are at least not always to be attributed to a diminished vigour or typhoid state of the system, or to a more virulent quality of the specific virus, but arise from an excess of inflammation occurring under a peculiar state of the patient's constitution, and ought to be subdued by an antiphlogistic system of treatment, independent of any subsequent treatment which may be necessary for the cure of the specific disease. It is, indeed, well known, in cases where the syphilitic sore shows a disposition to inflame much, or to slough, the exhibition of mercury is prejudicial, and ought not to be administered until all local as well as constitutional excitement is subdued.

In this class of cases, opium ought also to be freely given, and one or more grains may be taken every few hours, until the symptoms are relieved. These observations apply to wounds where the soft parts slough from the violence of the inflammation consequent to an injury.

In *hospital gangrene* the good effect of this treatment has been established in the most satisfactory manner by Mr. Boggie, an intelligent army surgeon, who met with many examples of that formidable disease in military hospitals during the Spanish campaigns, and for which he found venesection the most powerful remedy.

Cautions.—Hitherto those classes of diseases only have been pointed out wherein bleeding may be employed as the chief curative means; but there are other in which this energetic remedy ought to be used with much caution, and where doubt of its propriety may exist, although it be necessary for the patient's safety.

Blood-letting after the infliction of an injury is often employed very unnecessarily, and often, too, perniciously. I allude to the common practice of bleeding persons immediately after an accident, or during an apoplectic, or convulsive fit. In many accidents, particularly where the head suffers, the first effects of the injury are a diminution or collapse of the vital powers, the skin is cold, and the pulse small; if, under such circumstances, blood-letting be had recourse to, a still further diminution is produced. We should never bleed, until the powers of life have recovered, or some degree of reaction has taken place.

In Apoplexy.—Blood-letting has frequently been carried to a very unwarrantable, and even fatal extent. In proportion to the violence of an apoplectic shock so are the powers of life and vigour of the heart diminished; and hence, if the quantity of blood abstracted be regulated by the severity of the symptoms, in like proportion will such treatment be hurtful by still farther diminishing the vital powers. When a person is in a state of insensibility from an apoplectic fit, those around are too apt to urge the necessity of blood-letting, conceiving that the loss of blood will relieve the disease in the head, of which the fit is merely an effect or symptom[1].

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[1] A surgeon was sent for to see a patient, who had fallen down suddenly in an apoplectic fit; he immediately opened a vein, and after abstracting only a few ounces of blood, the pulse sank. When he visited this patient, several hours afterwards, he found the powers of life so feeble, that he ordered him cordials, by which the action of the heart and arteries began to revive. Soon after this, however, another surgeon was called in, and he repeated the venesection, after which the patient sank rapidly, and in a few hours expired.

When the approach of a paralytic attack is foreseen, or even the symptoms slightly commenced, it is astonishing to what an extent blood-letting must sometimes be carried, in order to check the progress of the malady[1].

There are cases of plethora or congestion in the brain, producing a sudden loss of the intellectual powers, and convulsions, in which too much blood can scarcely be removed to save life; but in such cases the pulse is stronger, and acquires vigour whilst the blood is flowing from the vein.

A general officer, of a full plethoric habit, and who had suffered occasionally from gout, had, in consequence of a slight pain in the great-toe, taken a brisk purgative, and whilst walking on the following day, which happened to be unusually cold, he felt a chill, suddenly became giddy, and fell down in the street, senseless and motionless, and his pulse, though strong, was little changed. I immediately opened a vein in the arm, and the blood flowed freely through a large orifice; at first the pulse gradually acquired strength, and increased in frequency, but was not subdued until upwards of forty ounces of blood were abstracted, and then he immediately became sensible to things around him. In a few hours the vigour of the heart and arteries revived, accompanied by uneasy feelings in the head, when the same quantity of blood was taken away as on the former occasion. These depletions, along with an antiphlogistic regimen, were the means of producing permanent relief.

There are also cases of apoplexy, in which there is congestion of blood in the brain, arising from diminished power of the heart to propel the blood. If in such cases, instead of stimulants, blood-letting be employed, the powers of life are so reduced that death soon follows.

When there is an organic change in the brain's structure, and when the sudden apoplectic attack is caused by some vessel of the diseased part of the brain giving way and pouring out blood, blood-letting is of no avail, and if had recourse to when the pulse is feeble, and the vital powers already much diminished, it never fails to hasten the patient's death.

In particular Inflammatory cases.—There are individuals in whom the loss even of a very small quantity of blood produces such exhaustion that it is impossible to carry depletion to the ordinary extent, even when they are labouring under inflammatory diseases. But these are constitutional peculiarities, of which we can only be aware by previous observation on the patient[1].

A nice point to determine in the employment of blood-letting, occurs in those cases of inflammation where the powers of life are already so much exhausted from the duration of the disease, that though there may be a probability of the inflammation being subdued by bleeding, yet the exhaustion produced by any further depletion would of itself destroy life. Under such circumstances, recourse should be had to other means for controlling the action of the heart and arteries, such as large and frequent doses of the tartrate of antimony, mercury combined with opiates, colchicum, &c.

In irregular Distributions of Blood.—Blood-letting will be found more or less injurious when had recourse to, where there is merely an irregular distribution of the blood, or undue quantity in a particular part, without any increase in the general circulation. Such cases are quite different in their pathological characters, both from those of congestion and of inflammation, and these three different conditions ought to be accurately distinguished.

In *congestion*, the quantity of the sanguineous fluid is increased, or the vessels of an organ are in a state of plethora. In an *inflamed part*, a change of structure is going on, so that if an organ in a state of congestion be compared with one which is inflamed, and macerated each in water, the blood of the congested is washed away, leaving the natural structure unchanged, whilst in the inflamed organ, besides an increased quantity of blood, there is a change in the structure of the organ, particularly an effusion of a sero-albuminous or puriform fluid, into the cellular membrane.

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[1] A patient complained of a numbness in the muscles of the right arm, and a tingling sensation in the fingers, which symptoms he had first perceived on shaving himself that morning. His pulse did not appear much changed, but it was not easily compressed. The action of the heart was unnaturally vigorous; his countenance had a tumid appearance and a leaden colour, but he had no uneasy feelings in his head, though he had walked a considerable distance to my house. I advised him to return home in a coach, and to be immediately bled in the horizontal posture, and forty-four ounces of blood were abstracted before syncope came on. The pulse soon began again to rise, and he was largely bled a second time twelve hours after the first bleeding, and also until he fainted. In forty-eight hours after the first bleeding, the action of the heart and arteries had greatly increased, accompanied with feelings of stupor and giddiness, notwithstanding his bowels had been very freely evacuated; he was therefore again bled at the arm till syncope came on, having lost in the three bleedings no less than a hundred and six ounces of blood! A few doses of calomel, which had been given along with strong purgatives, in a few days affected his gums, and created a good deal of mercurial fever, but his strength rapidly recovered after this went off, and in a few weeks all numbness left his arm, and its motions were so completely restored, that he could use a pen as well as before his illness.

[1] *Case.*—A lady about the middle period of life, who had suffered much from bad health, was suddenly attacked by the usual symptoms of peritoneal inflammation; suffering with a fixed pain in the abdomen, great tenderness to the touch, a very rapid pulse. I opened a vein in the arm, and before she had lost five ounces of blood, the pulse sank and she fainted. Two hours afterwards, she had recovered from the state of syncope, and her pulse was revived, but very rapid and easily compressed. The local pain not having abated, the bandage was replaced on the arm, and scarcely had a couple of ounces of blood been lost when the pulse sank, and she again became faint. The pain in the abdomen not being relieved, after having recovered from the state of syncope produced by the second bleeding, a grain of opium with five of calomel were given every few hours, by which treatment the pain and all other symptoms were rapidly subdued.

Where there is an *irregular distribution of the blood*, an undue quantity being sent to a particular part, there is a corresponding diminution of the blood in some other parts of the body, and it is in such cases the abstraction of blood is always useless or injurious.

We have examples of these irregular distributions of the head and chest. Persons suffering from bilious and aguish headachs, as they are called, frequently have a flushed countenance, and an increased action of some of the branches of the external carotid artery; but they are not accompanied by any of those changes in the arterial or cardiac pulse which indicate the use of blood-letting, and are marked by symptoms showing a diminution of blood in some other parts of the body, particularly in the limbs, by a painful sense of coldness in the feet.

Persons who have often suffered from bilious headachs, accompanied with a flushed face, and for which blood-letting has been ineffectually tried, may have feelings of uneasiness in the head of a different character, and of that description wherein bleeding is highly beneficial. I have known several serious errors committed from not being aware of this circumstance, and treating a headach from congestion of blood like an ordinary sympathetic headach.

Neglect of Blood-letting.—We have daily opportunities of noticing the changes of structure which take place in every organ of the body, in consequence of inflammations being allowed to advance, which, had they been detected early and treated by depletion, might have, in all probability, been subdued, and any permanent change of structure completely prevented.

There are, no doubt, many examples of inflammatory diseases, which have been completely relieved without blood-letting, some of them, when left to nature, running through a particular course, and leaving the affected organ unchanged; and there are others which are checked by the exhibition of those internal remedies which subdue the action of the vascular system. But there are many affections where the propriety of blood-letting has been indicated; and where, in consequence of its not being employed, the foundation has been laid of some substantial structural disease. I am indeed convinced, that in almost all those diseases which are, at their commencement, attended by the disturbed action of the vascular system, a much quicker and more complete abatement of the symptoms would result from venesection, pursued even to a very moderate extent, and the whole system suffer a much less subsequent debility, than by the free use of purgatives and diaphoretics, and a long continued perseverance in an antiphlogistic treatment.

Some peculiar effects of Blood-letting.—There is a curious effect of bleeding which was first remarked to me, in the following instance, by Professor Russell of Edinburgh:—A lady of a plethoric habit was very liable to sudden and severe congestions of blood in different parts of the body, most frequently in the lungs: the abstraction of a quantity of blood was indispensable. The moment a vein was opened she not only began to experience relief, but felt an instantaneous exhilaration of spirits, like one intoxicated. Mr. Russell repeatedly witnessed this very singular effect in the patient, and a medical friend of his witnessed an effect somewhat similar in another person.

Bleeding, too, not only increases the action of the bowels, but it promotes the mercurial action. Dr. Fordyce used to say that in some cases of constipated bowels, they ought to be opened with a lancet. The action of many other substances on the economy may be promoted in the same manner.

The remarkable effect of abstracting blood from domestic animals under different circumstances and for different purposes, is worthy of remark here. Horses who get into too high condition, as it is called, in which state a heaviness and want of activity supervene, if bled, acquire fresh vigour; and an acute observer informed me that he often found, if a pointer was bled on the morning of the day previous to hunting, the fatigue he could endure was infinitely greater than another dog in the same condition who had not lost blood.

OPERATIONS.

Arteriotomy (from ἀρτηρία, an artery, and τέμνω, to cut), or blood-letting from an artery, is an operation of high antiquity. Celsus makes mention of it, and Galen complains that his contemporaries neglected it too much. Prosper Albinus represents it as in frequent use amongst the Egyptians. In the present day, it is employed almost solely on the temporal artery, or its branches, the auricular and frontal, as from their superficial situation on the external surface of the cranium, peculiar facility is afforded after the operation for arresting the flow of blood by compression. In a preceding part of this article, it will have been however remarked, that in cases where there is great difficulty of obtaining a flow of blood by other means, this operation might be extended to other arteries when favourably situated for compression against bone, such as the dorsal artery of the foot, and of the hand the lower part of the radial; this last vessel, it is there stated, has been opened under a necessity of this kind. The operation may be performed with a bistoury, a straight pointed, or a common lancet. The surgeon being provided with a compress and roller, shaves off the hair of the temple, when the artery and its branches may not only be felt, but the pulsations may be distinctly seen. When this is not the case, its situation and course are readily explored by the index finger. If the branches be large, it will be unnecessary to perform the operation on the trunk itself, when otherwise, the trunk of the vessel should be opened.

The patient being in the recumbent posture, or seated on a low chair, with the head turned on one side, and resting on an assistant, the surgeon explores the course of the artery, and marks with ink the situation of his incision. Supposing that he bleeds from the left temple, he fixes the vessel, by pressing on it with the index and middle fingers of the left hand, leaving between them the ink mark uncovered for a little way on each side. If the artery be superficial, and pulsates strongly to the touch, the integuments and vessel may be divided at a stroke, if not, the first incision divides the integuments only; the artery is then seen lying on the aponeurosis, which covers the temporal muscle, and may be punctured with the point of the instrument. Ordinarily the integuments are first divided, the puncture or complete section of the artery forming the second step of the operation. The performance will be facilitated, if the patient keep his jaws firmly locked, as the artery meets the knife with more resistance, it being supported by the contracted temporal muscle. Some surgeons make the first incision by first pinching up the skin, and then dividing it. The course of the artery is generally about an inch above the zygoma, and nearly two inches forward from the ear. If it be desired to obtain any considerable quantity of blood, the puncture should be made on the trunk of the vessel, half an inch above the zygoma; indeed the general objection to arteriotomy is that a sufficient quantity of blood cannot be obtained, and the surgeon is in consequence obliged to have recourse to venesection ultimately. When the opening is sufficiently large, the blood flows *per saltum*. When it flows languidly and in a small stream, it may be assisted by pressing the vessel with the finger above the puncture, or by gently fillipping the trunk itself, while the patient at the same time is directed to move the lower jaw as in the act of mastication. The blood should be prevented from streaming into the ear or down the cheek, and with this view, the French surgeons recommend forming a channel for it with a piece of card-paper.

If the artery has been completely cut across, the bleeding in general ceases spontaneously. This will also happen in most cases where the vessel has been merely punctured. The lips of the wound are then brought together with adhesive straps, and the graduated compress and roller are at once applied, making a few turns of the latter round the forehead, occiput, and over the temple with moderate pressure. If hæmorrhage should recur, the bandage must be removed, and the vessel divided completely; this will allow the divided extremities to retract, when the bleeding will immediately cease. When the artery has been thus divided, neither hæmorrhage nor aneurism are to be feared as a consequence.

Phlebotomy (from φλὲψ, a vein, and τέμνω, to cut), or venesection, is the common mode of blood-letting, and may be performed at the bend of the arm, at the ankle, on the external jugular vein, the brachial or cephalic vein in its ascent to join the axillary, the veins on the back of the hand and foot, the frontal veins, and those under the tongue. The place of election is the bend of the arm, and for the anatomy of the veins of this region, the reader is referred to the article under that head.

Fig. 155.

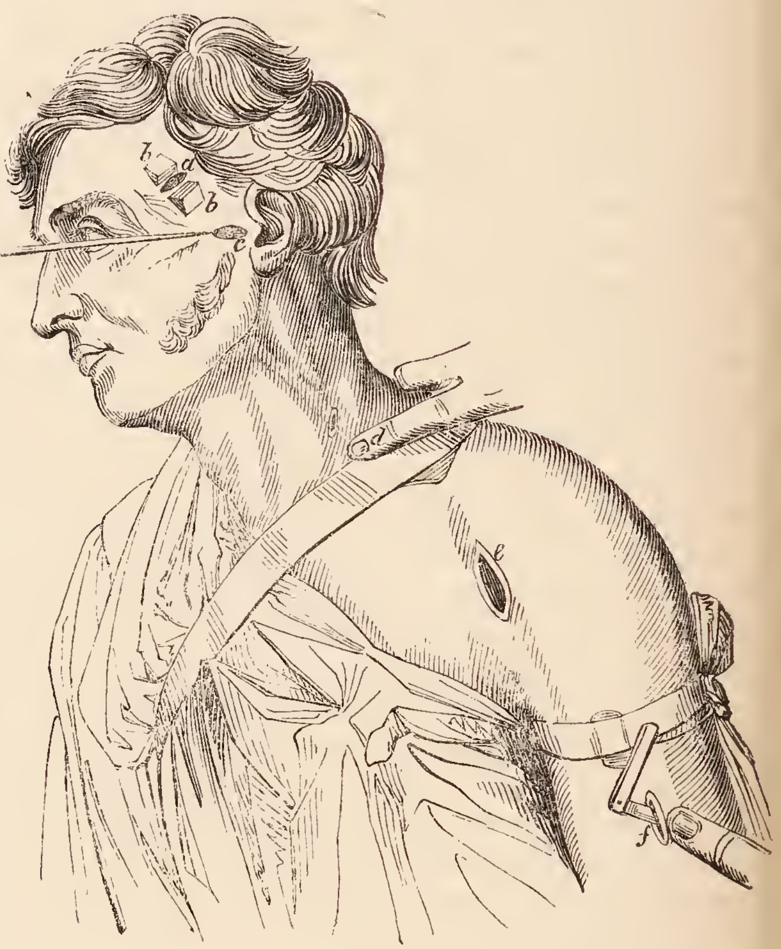


Fig. 155 represents arteriotomy of the temporal artery and its frontal branch, and venesection of the jugular, cephalic, and brachial veins. a, the frontal artery divided; b, b, the graduated compresses; c, the temporal divided; d, the operator's finger, making pressure on the jugular vein; e, the incision of the integument to expose the cephalic vein which runs upwards between the deltoid and pectoral muscles; f, the brachial vein.

Venesection, though one of the commonest operations in surgery, is by no means generally well performed. The instruments necessary are a bandage to compress the veins, and to bind the wound afterwards, a lancet, which should be clean and sharp, a vessel to receive the blood, a compress, and a glass of pure water. When the operation is performed at the bend of the arm, the patient may be placed in the sitting, or in the recumbent posture, according to the object in view. In opening a vein, it is necessary to stop the current of blood by compressing the vessel between the point to be punctured and the heart; the bandage must therefore be applied, in bleeding at the arm, just above the elbow, but not at too great a distance, as otherwise the vein would yield and roll before the point of the lancet. A few lines above the point of puncture will be sufficient. The bandage should be applied with a tightness sufficient only to interrupt the current of blood in the superficial veins, thus causing them to become turgid, but not to produce the cessation of the pulse at the wrist. The bandage should be applied flat on the front of the arm, and after being wound once round it, should be tied on its outside. The arm is then allowed to rest in a semi-flexed position on the bed, or on the patient's knee for a few moments, while the surgeon takes his position, and opens his lancet. He then lays hold of the patient's arm, applying the thumb of his left hand on the vein, so as to fix it firmly, and resting his right hand, armed with the lancet, on the patient's arm, he punctures the vein in a somewhat oblique direction, carrying on the point of the lancet, until the incision is of a sufficient size to allow of the free flow of the blood. In this, there are two movements, one of puncturing, and one of incising. The thumb is then removed, and the limb is supported in such a manner as to direct the flowing blood into the basin prepared for its reception. The obliquity of the incision is important, particularly where the veins are small or deep-seated, to prevent failure of the operation or the occurrence of ecchymosis.

If the bandage be properly applied, and with the proper degree of constriction, the puncture be sufficiently large, and the vein of ordinary calibre, there will be no difficulty in obtaining the desired quantity of blood. The surgeon supporting the arm, sees that nothing stops the stream, by changing the relations of the puncture in the vein, and that of the integuments, and further promotes it by passing his hand upon the course of the veins from the wrist towards the bend of the arm, or by directing the patient to work his fingers on a lancet-case, or any round substance; this action of the muscles of the arm, quickens the flow of blood through the veins. If the blood while flowing forms a coagulum in the wound, thus diminishing the size of the stream, it ought to be rubbed off with a towel. Should the impediment arise from the protrusion of a granule of fat through the wound, it should be snipped off with a pair of scissors, or set aside with the point of a probe.

When a sufficient quantity has been abstracted, the thumb of the left hand is placed on the wound, or on the vein just below it; the bandage is then removed, and the arm being wiped, and the lips of the wound brought together, the compress is applied on the wound, and secured by the bandage, which is applied in the shape of a figure of 8, the crossings being made to correspond to the position of the compress. Great pressure is not necessary, and might be hurtful, by causing the veins to become turgid; all that is required is to keep the compress steady in its place. The bandage should remain on for twenty-four hours, during which time the arm should be kept as much at rest as possible, and in a semi-flexed position.

If the disease for which the bleeding has been resorted to, be of such a nature as to require repetition, it will be unnecessary to puncture another vein, if the surgeon take the trouble of observing one simple precaution, viz. to prevent the adhesion of the lips of the wound, by anointing them with simple cerate before applying the compress and bandage. On making the second bleeding, all he has to do is to apply the ligature above the elbow, as in the first instance; and as soon as the veins have become turgid, a slight, quick blow upon them just below the wound will break up the tender coagulum that fills the orifice in the vein, when the blood will stream forth afresh; this may also be effected by rubbing the vein from below upwards.

Fig. 156.

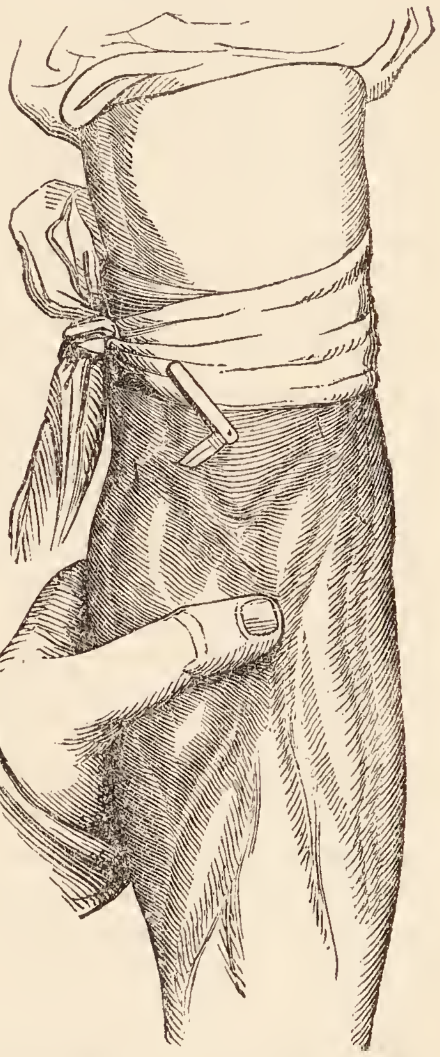


Fig. 156 represents the arm bound with its veins distended. The operator's thumb is pressing on one of the venous trunks. Lancet punctures are visible at various points of the veins of this region.

Difficulties and accidents in blood-letting.— The ill-effects of wounding the brachial artery, or of puncturing the branch of a nerve, have been already considered, together with many other points bearing on this subject, under the head, Arm, Bend of. We shall here advert to the more ordinary circumstances attending the operation.

Sometimes it is impossible to discover any vein, either by sight or touch. If, however, the ligature be applied for half an hour, and the arm be plunged in warm water, while the patient at the same time causes the muscles of his arm to contract, one or two will often become apparent, and even sensible to the touch. The plunging the arm into hot-water is of doubtful efficacy, for though it will help to render the veins turgid, it also reddens the skin, and expands the cellular tissue to the extent of masking the veins completely. When none can be found, the ligature should be placed on the wrist or ankle, with a view to obtain blood from the largest vessels, that may be found in either of these situations. In fat persons the first puncture of the lancet often does no more than expose the vein at the bottom of the wound: in such a case, a second puncture should be made to procure the flow of the blood.

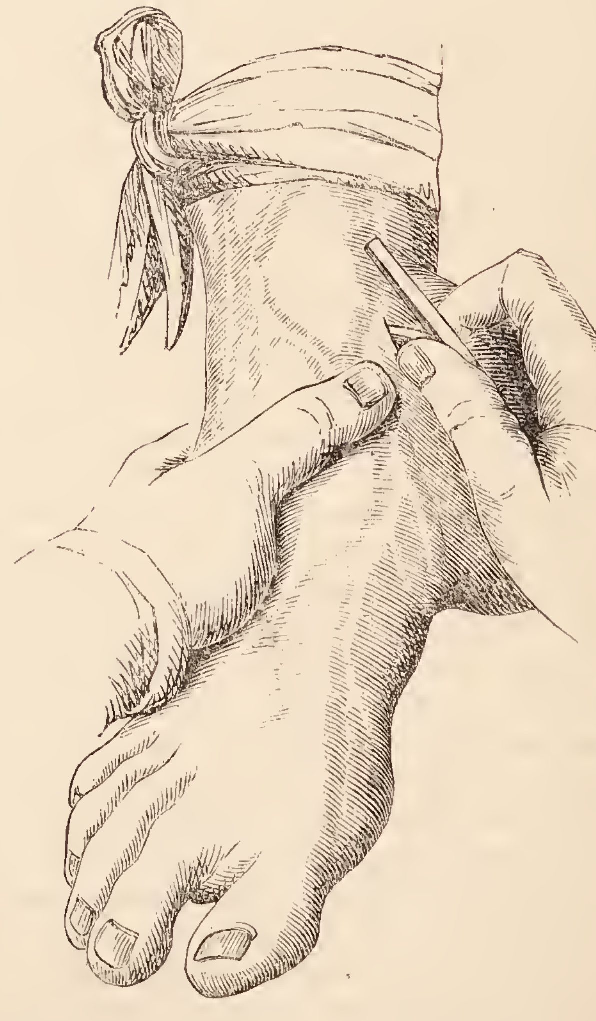
Sometimes after the blood has for a moment gushed out in a full stream, it ceases all at once. This may depend on the ligature above being too tight to allow the circulation of arterial blood, so that the supply to the punctured vein soon ceases; in this case, the ligature must be slackened. When the ligature, on the other hand, is too loose, the blood does not flow, but trickles slowly out of the wound. Much, therefore, depends on the manner of applying the ligature, not only in regard to the rapidity and effect of blood-letting, but also to the preservation of the parallelism between the wound of the vein and that of the skin. The want of this may stop the flow of blood altogether. The evil is often produced from the vein being punctured while the arm is in supination, and from its being immediately thrown into pronation, in order to direct the stream into the basin, or from the arm being bent, after having been previously extended. These changes of position should be as much as possible avoided. The parallelism will be best restored by replacing the arm in the position in which it was when the vein was punctured. If the first puncture be too small, it should at once be enlarged sufficiently to allow of a free flow of blood.

Another evil, which arises under the circumstances just mentioned, is ecchymosis, or thrombus, as it is sometimes called. The parallelism must be re-established at once; and if that cannot be done, the wound must be enlarged, in order to prevent the extravasation of blood from extending further into the cellular tissue. If the flow of blood externally has entirely ceased, the ligature should be removed, and another vein opened. The tumour thus formed may be left to nature, or absorption may be expedited by the application of a compress, moistened with spirit, or vinegar lotion. Inflammation of the cellular tissue may also arise. This is to be combated with leeches, saturnine lotion, and rest of the limb.

External jugular vein.—When this vein is to be opened, the patient is seated on a chair or bed, the head supported, and turned on one side; a thick compress is then placed on the vein, between the point to be opened and the heart; this is secured by means of a bandage, or rolled cravat, the two ends of which are brought down into the axilla of the opposite side. The circulation in the vessel may also be interrupted by making pressure with the thumb. The vein being thus rendered turgid, the surgeon places his index finger on the vein about an inch higher, to steady it and stretch the skin, and at once opens it by a larger and deeper incision than that which is usually made on the veins of the arm. The flow of blood is easily arrested; and for this purpose nothing more is necessary than to remove the compress and bandage. But here a precaution of great importance must be observed, to prevent the possibility of air being drawn into the vein. The thumb should be kept pressed upon the vessel until the lips of the wound have been accurately brought together, and secured with an adhesive strap. If the vein be deep-seated, the skin covering it, including the fibres of the platysma myoides, may first be divided, by pinching them up; the vein thus laid bare is then punctured longitudinally. If the blood does not flow freely, it may be assisted by the patient moving his jaw as in masticating. (See Fig. 155.)

Saphena vein.—The different branches of this vein are easily rendered turgid by putting the foot into warm water. The bandage is then applied a little above the ankle, and the vein, which is here very superficial, being merely covered by the skin, is at once punctured. The blood may be received in a basin, or the foot may be replaced in the warm water, the wound being on a level with the surface of the water, so as to allow the surgeon an opportunity of seeing that the flow continues, and of judging of the quantity abstracted. The bleeding is promoted by working the toes. A compress and bandage are applied to secure the wound, as in blood-letting at the arm.

Fig. 157.



The different modes of topical blood-letting will be described under the heads CUPPING and LEECHES.

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(*W. B. Costello.*)

BOIL, see FURUNCULUS.

BONE, DISEASES OF. (*ὀστέον*, Gr.; *os*, Lat.; *Bein*, Ger.; *os*, Fr.) The physical properties of bone in a healthy state, are such as render it admirably adapted for the offices it fulfils in the animal economy. It serves to protect delicate organs; it affords a series of levers, by means of which the muscles execute the commands of the will; it is a general and permanent model for the figure, and a firm support for the body. For these purposes it is formed very hard and tough, slightly flexible and elastic. Were its hardness less, its flexibility greater, strong efforts could not be performed, and the limbs would yield under the weight of the trunk. On the other hand, if it were destitute of elasticity, shocks it now supports with impunity, would suffice for its destruction, and that of the important organs it is framed to protect.

This union of hardness and flexibility results in a great measure from its chemical composition. It consists of an animal framework in which earthy and saline matter is deposited. It is to the former it owes its elasticity, to the latter its hardness; for if the animal matter be removed by calcination, or digestion in a solution of caustic potass, the bone becomes extremely brittle and friable, while if the inorganic substance be dissolved by a solution of hydrochloric acid, a bone of moderate length can be readily twisted into a knot. Berzelius states that in a hundred parts of adult bone, about thirty-three are animal, sixty-six earthy and saline matters. Dr. John Davy pointed out that the quantity of inorganic matter became greater as age advanced. This is exactly in accordance with the habits, wants, and powers of the subject; and on carrying out the question in the animal kingdom, it is found that the relative proportions of the constituents of bone in the various classes of animals, are beautifully arranged, to afford such a degree of strength and power on the one hand, or of flexibility on the other, as may secure their physical well-being in the most perfect manner. Schreger, who has followed up the researches of Davy, states that in the bones of children, one half is animal matter, in the adult only a fifth, and but an eighth in the old person.

The structure of bone also affords a convincing proof of design in the manner in which great strength is secured without bulk, and in some parts a large surface without inconvenient weight. It would not only be out of place, but premature to discuss the minute structure of bone, the ultimate arrangement of its component particles, before the investigations of Deutsch, Purkinje, and Miescher, shall have been fully carried out. It is sufficient for our purpose to state, that the texture of bone differs greatly in its different portions. The outer portion consists of a layer of very dense and compact structure; the internal, of an areolar or spongy substance. The square bones and the articular extremities of the long bones have the outer layer thin, the internal cancellated structure thick and strong. The shafts of long bones have the outer layer very thick, the internal laminæ exceedingly delicate. In the flat bones there are two layers of compact tissue, the cancellated structure being between them and there termed diploë. This difference of texture results merely from the different arrangement of the laminæ or fibres, which are closely aggregated in the compact, but more separated in the looser tissue, forming intermediate cells. By this contrivance symmetry is preserved without loss of power, vibrations which would injure important organs are broken, and the vital forces are economized.

With a few obvious exceptions, every part of the surface of bone is covered by a fibrous membrane periosteum, the vessels of which can be shown by injection. They freely anastomose with those of the surrounding textures, and with branches of the medullary artery in the substance of the bone. The principal use of the periosteum is to serve as a bed in which the vessels may ramify before they enter the bone. Hence the bone is in a great degree dependent on the integrity of this membrane for its supply of blood, and we can therefore readily perceive the important influence it must exert over the diseases of bone; for if it be removed to any extent, a superficial layer of bone almost invariably dies. It is also an efficient agent in the growth of bone, and the reparation of fractures.

A tubular cavity exists in the shafts of the long bones, which is lined by a fine membrane, composed of the minute ramifications of blood-vessels in delicate cellular tissue. This membrane sends off numerous prolongations forming cells, which contain a soft reddish fatty matter, the medulla; or rather support minute vesicles containing it, as described by Havers. This membrane also exerts considerable influence in maintaining the vitality of bone; for if it be extensively injured, the bone perishes.

Bone is organized by a supply of arteries, veins, nerves, and lymphatics. Arteries enter bone, after ramifying in the periosteum, through minute holes in the surface. One or two large vessels also pass through distinct foramina, and ramify on the medullary membrane. Both series freely anastomose, and keep up a tolerably active circulation. The medullary arteries have accompanying veins; other veins also pass out of the bone through distinct foramina, and empty themselves into the veins of the surrounding soft parts. They are said to be furnished with valves, and to have but one coat, the internal.

Bones are insensible when healthy; under disease, however, they become very sensitive. This would be sufficient to prove that they are supplied by nerves, even if Mr. Swan had not demonstrated the fact. The existence of lymphatics is inferred from the processes of ulceration and absorption which go on in bone.

The bones, then, are organized structures, and, as such, are subject to the same laws as the softer tissues, not only in a state of health, but also when under the influence of disease. Their organization, however, though the same in kind, differs materially in degree, and from the large proportion of earthy and saline matter contained in them, they may be said to hold an intermediate place between organic and inorganic bodies. We find the bones of children far more liable to acute diseases, than those of adults, and this results from the larger quantity of organized matter the former contain. A wound of the soft parts is healed in a few days, while it requires weeks and months to effect the perfect reparation of a fracture. Here again our argument holds good, reunion of fractures occurring most rapidly in the young. The same reasoning also applies to the diseases of the different parts of a bone; for the denser the texture, the less is its supply of blood, and the lower its organization: on this ground the outer or compact tissue of bone having less vital power is more prone to die from disease or injury, while the cancellous structure approaches the softer tissues more nearly in the nature of its diseases, as it does in the character of its organization.

As the processes of assimilation and growth are much less actively carried on in bone than in the soft parts, so the progress of disease is much less speedy. The effects, however, are more permanent, and by no means so amenable to treatment, a long continuance in the use of remedies being necessary before evident benefit results. The sympathetic relations of bones also under disease, strictly accord with the low state of their vital endowments: for although they certainly occasionally participate in some general disorders of the system, scurvy, mercurial cachexia, &c. still we frequently see cases of extensive osseous disease, the constitution of the patient being unaffected, or merely suffering from the effects of severe or long-continued pain. On the other hand, bones remain quite intact, while the rest of the system is agitated by acute diseases. This could not occur in the soft parts, the different organs being mutually dependent on each other, and the whole being intimately connected by nervous communications.

After taking these points into consideration, the following appears to be a natural arrangement of the diseases of bones.

I. Functional affections, or lesions of innervation.

II. Abnormal changes, the result of defect or excess in the nutritive or assimilative powers.

III. Simple and specific inflammation of bone, and its membranes, with the consequence of such inflammation.

IV. Morbid growths, deposits, or formations.

V. Malignant diseases.

I. Bones being merely passive agents, it may at first sight appear somewhat paradoxical to assert that they suffer from functional disorder, independent of structural changes. It would appear, however, that their nervous sensibility may be so much exalted, as to render them incapable of affording support or resistance without pain, and this sometimes to so great a degree, as to render the least motion insupportable, there still being no trace of vascular hyperhæmia. I am convinced these observations will apply to the periosteum. There can be few practised auscultators who have not occasionally observed such an exquisite tenderness of the thoracic parietes of their patient, as to render the application of the stethoscope or the employment of percussion extremely painful. This will frequently arise from morbid sensibility in the sentient extremities of the cutaneous nerves, the result of spinal irritation, or uterine derangement. In such cases the slightest touch gives pain, but on continuing the pressure for a few seconds, pretty considerable force may be exerted without producing suffering, and there is often tenderness on pressing the spinous processes of corresponding vertebræ. I have, however, seen two cases which I am led to believe are examples of an extensive class, where this morbid irritability was not seated superficially, but in the periosteum covering the ribs and cartilages (perichondrium). Both were young men who had fallen into phthisis after syphilis, and the free use of mercury. Great pain was caused by percussion, but there was no spinal tenderness; the integuments might be pinched up between the fingers without causing pain, nor did it result from pressing the intercostal spaces. But directly the stethoscope impinged on the periosteum, the patients started away, or pushed off, the instrument. This was nearly constant, but a day occasionally occurred when it was not so. Both patients died, and I examined the periosteum most carefully, but could not trace the slightest evidence of vascular injection, or any result of inflammation. A practical hint of some value to young stethoscopists may be deduced from these remarks: it is, to be particularly cautious in passing the fingers over the chest of a stranger before employing percussion, as the severe pain produced in these cases by any rough manipulation, would be very likely to operate to the prejudice of the practitioner. As to the treatment, it will consist of means likely to restore power to the system, and if nothing contra-indicates its employment, small doses of the iodide of potassium in some strong preparation of sarsaparilla.

II. We have now to consider the changes resulting from defect or excess, in the nutritive or assimilative powers.

Our space prevents us entering into a consideration of the ingenious views of Muller on growth and nutrition; it suffices to say that a constant change goes on in the materials of which the body is composed, both fluids and solids: old matter is removed, new matter is deposited or assimilated. In order that this should go on with regularity and precision, so that the size, form, structure, and chemical composition of the various textures may be preserved, a wonderful balance must be kept up between the processes of digestion and assimilation, and the general vigour of the whole system, especially in youth when growth is going on, and the exchange of material necessarily most rapid. Supposing then this balance to be deranged, and there results simple defect or excess in the processes of nutrition or absorption, the relative proportions of animal and inorganic matter remaining unaltered, we have either hypertrophy, or atrophy. If there be a want of proportion between these substances, resulting either from diminished deposition, or increased absorption, the effects are either rachitis, mollities ossium, or fragilitas ossium.

1. Hypertrophy of bone signifies abnormal excess in its developement, the structure remaining unaltered. It may be general, affecting the whole osseous system; but this is very rare, and is usually accompanied by a tendency to bony deposition in other parts. A single bone may be hypertrophied throughout its whole extent, and it is not very rare to find them increased in thickness. This is generally in strong muscular subjects; for as we find that throughout all classes of animals a constant relation exists between the developement of muscle and the weight of bone, so in man, where there is great muscular power, bone is supplied in proportion. Were this not the case, fractures would frequently happen merely from violent muscular efforts, an accident which sometimes occurs under some conditions of osseous disease. To a certain extent, therefore, hypertrophy may be considered as an effect of excessive healthy action.

It is very rare to find a bone lengthened from hypertrophy; there are, however, in the museum of St. Bartholomew's hospital, sections of two tibiæ so much elongated from this cause, that they have become considerably curved, in order to adapt themselves to the fibulæ, which remain of their natural length. The hypertrophy is confined principally to the cancellated structure. It is probable that hypertrophy does not always result from increased nutrition, but sometimes from diminished absorption; and this supposition gains strength from the power iodine possesses in removing that form of exostosis, which is the mere effect of partial hypertrophy. Iodine is generally supposed to have considerable power in stimulating the absorbent system; and if by this excitement hypertrophy be removed, some would infer that a deficiency in absorbing power was the cause of the disease. We must have more certain data, however, on which to explain the modus operandi of iodine before these premises can be established; and even then the conclusions would be open to exception.

2. Atrophy of bone is a state exactly opposite to that of hypertrophy. The causes may be a general defect in the nutritive and assimilative powers of the system, and in this case many of the bones suffer. This is exemplified in children who grow rapidly. The soft parts increase very speedily, and the structural growth of bone not keeping pace with them, the osseous system suffers a comparative arrest of development. Various causes may operate to produce atrophy of a particular bone. As the soft parts waste when not exercised, so bone if kept long in a state of perfect rest loses its size and weight. Cases are recorded of persons long confined to bed, in whom the bones became so soft as to be readily cut with a knife, and their texture so loosened as to be easily unravelled. Part of a bone only may be atrophied, of which a familiar instance is afforded in the sternum, when undergoing pressure from an aneurism of the thoracic aorta. This has been, absurdly enough, described as a form of caries, but it is really nothing more than partial atrophy, from diminution in the supply of blood to the part. The vessels of the bone are pressed on and obstructed by the aneurism, nutrition thereby prevented, and the bone either dies, or is removed, the process of absorption being undiminished. In the museum of University college is a thigh-bone, which has been reduced to a mere shell in its lower part, by the pressure of a popliteal tumour; and analogous preparations are met with in most collections.

In the twentieth volume of the Medico-Chirurgical Transactions, Mr. Curling has endeavoured to prove that bones undergo a form of atrophy, when deprived of nervous influence. It appears doubtful, however, whether in the instances he has brought forward the atrophy is not to be ascribed fully as much to inaction as to loss of nervous influence. But that atrophy should result from any cause destroying the connection between a bone, or part of it and the nervous centre, is what we should expect from the influence we know the nervous system possesses over the capillary circulation and the process of nutrition; and, therefore, we can readily understand how, in the interesting case, recorded by Mr. Travers, "union between the ends of a fractured leg, that was paralyzed from fracture of the lumbar vertebræ, failed to proceed; whilst the extremities of the humerus, fractured at the same time, united perfectly in the usual period."

Mr. Curling has shown that a form of atrophy in which the cancelli are enlarged, and the walls thinned, results from the supply of blood by the medullary artery being cut off. He found that in femurs and tibiæ, fractured below the entrance of the medullary artery, the inferior of the fractured extremities was thus atrophied, while in the humerus broken above the entrance of the medullary artery, the superior fragment underwent this change. This is in accordance with the direction of the medullary artery, which Mr. Curling considers as the proper nutrient vessel of the bone, and is an interesting example of the benefit derived from a knowledge of minute anatomical observations in explaining physiological facts. The atrophy apparently results, as Mr. Curling explains, from the unyielding nature of the canals through which the periosteal arteries pass; for although the branches of the periosteal and medullary arteries freely anastomose, the former vessels cannot increase, as those of the soft parts, so as to keep up the necessary supply of blood.

3. By fragilitas ossium we mean a morbid brittleness of bone; a state in which it breaks under very slight injury. In many cases this is the result of atrophy: the walls of the bone being thinned, and the cancelli widened, a mere shell remains, which is fractured so readily that it has given rise to the term spontaneous fracture. I saw a patient of Mr. Wainwright's of Barnsley, last year, a person of very slight muscular power, whose humerus broke when she was wringing a piece of linen she had been washing; and Mr. S. Cooper mentions a case in which the humerus of a boy was broken by shampooing. In another class of cases fragilitas arises from the quantity of inorganic matter being in excess, which it has been stated is frequently the case in the bones of the aged. Hence old persons are more liable to fractures than are adults, considering the less amount of risk they are exposed to; and it is probable these accidents would be still more frequent, were it not for the large quantity of oily matter that becomes infiltrated through the osseous tissue in advanced life. M. Ribes [1], however, considers that senile fragility does not depend so much on excess of inorganic matter, as in a defect in the quantity of all the materials forming bone; in other words, on pure general atrophy. Just as the muscles of an old subject cannot effect the feats of a young one, so the bones are unable to support the same shocks. Though this is probably correct in many instances, still the experiments of able chemists have been so numerous, repeated, and conclusive, that fragility from excess of inorganic matter may be regarded as a pathological fact, which is not to be invalidated by the speculations of any man, however sagacious. Mr. Porter supports the view of M. Ribes, and his opinion is worthy of respectful attention; but we cannot agree with him, that, because in a few instances, he could detect no superabundance of earthy matter in the bones of old persons, that Davy, Schreger, and others, have never done so. And if we allow that fragility may arise not only from disproportion between the elementary constituents of bone, but also from general or partial atrophy, the opposite opinions may be reconciled. The bones of persons suffering from cancer, scrofula, scurvy, and mercurial cachexia, are sometimes easily broken; but this condition can scarcely be described as brittleness, though classed under that head by most systematic writers. So far from being brittle, their texture is generally softened by the interstitial deposition of morbid substances.

4. The term rachitis is generally understood to imply a certain disease peculiar to bone. This, however, is incorrect. The bones only participate with other parts in debility of the whole system, the phosphate of lime being deficient in them, as the quantity of fibrin is in the muscles. The want of energy in the development of the osseous system is shown by the tardy appearance of the teeth, or their speedily falling out after they have appeared, the frequent occurrence of which in rickety children was noticed by Lieutand. The earthy matter being deficient, the animal remains in such excess, that the bones are soft, and yield under the superincumbent weight. Monro states, that in some cases 74, 75, and 79 parts in 100 consisted of animal matter. In the worst forms of rachitis the compact structure is thinned, the cells of the areolar structure expanded, and filled with a gelatinous fluid; but a rickety bone more generally approaches the appearance and consistence of cartilage. There is not only a want of proportion between the quantities of animal and inorganic matter in this affection, but sometimes so much phosphoric acid is secreted, that the phosphate of lime, an insoluble salt, is converted into a biphosphate, which is soluble, and of course more readily acted on by the absorbents. It is not improbable that this is the first link in the chain of morbid action in some cases where there was no original deficiency of the earthy salt. That there is no want of the materials in the system is shown by the undue secretion of phosphates by the

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[1] Dict. des Sciences Méd. t. 38.

kidneys under rachitis. Some have regarded this as a vicarious action, because it usually ceases as recovery goes on. Mr. Stanley has made many interesting observations on the mode in which reparation is accomplished, which, with the causes, symptoms, effects, pathology, and treatment, will be fully discussed in the article Rachitis.

5. Mollities ossium is a bad term for a disease which may be the effect of various and opposite causes. It merely implies softness of bone, and, therefore, might fairly be applied to a rickety bone, or to one softened from any morbid infiltrations. The term, however, in its conventional sense, signifies a morbid condition of bone, characterized by softness, which does not arise in young persons, as in rachitis, from primary deficiency in the deposition of earthy matter, but generally affects the old; and as in these bony matter has been formed, its deficiency is explained by absorption. One form results from infiltration of the tissue with oil, and others from morbid deposits and malignant diseases. See Osteomalaxy.

III. We have now to say a few words on inflammation of bone and its membranes, with its effects.

The general introductory observations on the diseases of bone, apply with peculiar force to inflammation of its tissues, which is characterized by the same signs as in the soft parts: its effects or consequences are similar; and its progress strictly in accordance with the physical properties and vital endowments of the structure. Increased vascularity, heat, swelling, and augmented sensibility, mark the occurrence of inflammation, and the consequences, as, in the soft parts are induration, thickening, adhesion, suppuration, ulceration, and mortification. The induration of bone from the effect of inflammation is termed eburnation, and is not unfrequently met with. The thickening, from the same cause, constitutes one form of osseous hypertrophy, or hyperostosis, of which there are several specimens in the museums of St. Thomas's and St. Bartholomew's hospitals. Most of the instances, I have seen apparently unconnected with primary periosteal disease, are general thickening of the cranium, with increased vascularity; but the great majority of the preparations I have examined of this form of hypertrophy in the long bones, are evidently the result of periostitis, and consequent deposition of osseous matter, by which the compact structure of the bone is greatly thickened, the cancellated structure and medullary canal remaining unchanged. The adhesive inflammation in bone is exemplified in the reparation of fracture. Suppuration occurs in all parts of bones, but most frequently in the articular extremities of the long bones, or immediately beneath the periosteum. There are also preparations in the museum of St. Thomas's hospital, where an abscess has formed in the compact tissue, apparently unconnected with disease either of periosteum or medullary membrane. Pus is also occasionally found in the medullary canal. In any of these situations it is generally the result of chronic, very rarely of acute inflammation. All the circumstances connected with this subject will be fully treated of in the articles, Fracture, Ostitis, and Periostitis.

A process analogous to the ulceration of soft parts occurs in bone, and is termed caries, to which process the appellation should be restricted. Sanson regards it as a suppuration of the animal framework, which being thus destroyed, the inorganic matter deposited in it is necessarily thrown off. The process of reparation, as in the soft parts, is by granulation and cicatrization. (See Ostitis.) The granulation, however, is never sufficient to effect a perfect restoration, as in the soft parts, the excavated surface being chiefly filled by a fibrous substance.

Mortification of bone is termed necrosis, from *νεκρόω*, to destroy. Some writers have used the terms caries and necrosis almost indifferently, whereas the only circumstance in which they resemble each other is, that both may result from the same cause, inflammation. Others, again, define mortification of bone by the term exfoliation, and consider necrosis as death accompanied by a process of reparation, in which new bone is formed around the dead, to support the body, whilst the latter is being separated by absorption, and holes are formed in the new crust, communicating with the surface, through which the dead bone is discharged. The truth is, if a bone be dead, it is necrosed; if a part of it be dead, that part is necrosed, or destroyed, whether a process of reparation follow or not; and exfoliation, which means the falling away of a leaf, is the separation of a superficial layer of dead bone. See Necrosis.

It is a matter of every-day experience, that the periosteum may be inflamed, without implicating the proper osseous tissue. Its effects are tumefaction, thickening, or induration of the membrane, frequently accompanied by deposits either of purulent, cartilaginous, or osseous matter, between it and the bone. See Periostitis.

It is the opinion of M. Sanson, that it is almost impossible to separate the affections of the medullary membrane from those of the osseous tissue. He regards this membrane, however, as the seat of the pains suffered by syphilitic patients, on what ground I am not aware. It certainly must be very difficult to distinguish these different seats of inflammation during life; but any one may readily convince himself by a walk through our museums, that morbid growths originate in this membrane, and that the usual consequences of inflammation are here developed, other parts of the bone being primarily unaffected. This, however, will be fully considered in the article Ostitis.

Inflammation of bone and its membranes may be simple, arising in a healthy person from some common cause, as cold or injury. It may also be modified by a general cachectic state of the system, by scrofula, or specific taints. It will be hereafter considered how far this inflammation can be distinguished in its effects from the simple form, by mere local appearances, and the characteristic appearances of each pointed out as far as they are known.

IV. Morbid deposits, growths, and formations.

The most frequent morbid deposit met with in this country, is one of a curdy matter, in connexion with a peculiar state of the system termed scrofula. Its usual seat is the cancellated structure forming the articular extremities of the long bones, in the bodies of the vertebræ and in the bones of the carpus and tarsus. From some microscopic observations I have recently made, I am more inclined to regard this deposition as a kind of deteriorated lymph, the result of inflammation, which had been modified by the debilitated state of the constitution of the individual, than as a deposit of the granular matter we find in the lung, &c., and call tubercle. In the first stage of this affection the increased vascularity of the part is often appreciable by the eye, always demonstrable by injection. The medulla, which filled the cancelli, is then gradually removed, and its place taken by a yellowish white curdy matter. As the disease advances, the bony cancelli become broken down, partially absorbed, or mixed with the morbid deposit, the bone is rendered lighter, and may be cut with a knife. The disease goes on to produce ulceration of the cartilages of the neighbouring joint, and the formation of abscesses in the soft parts communicating with the bone, the vascularity of which has become so much diminished, that exfoliations are common. This subject, however, is so intimately connected with that of diseases of the joints, that it will be considered among them.

The other morbid deposits, not malignant, have been before adverted to.

A disease exists in bone, which Breschet regards as analogous to erectile tumours in the soft parts ; it is a species of pulsating tumour, the primary cause of which consists in aneurismal dilatation of the arteries of the bone, in other words, the " aneurism by anastomosis" of Bell. Lallemand relates a case of this kind, which is said to have been cured by ligature of the femoral artery. Mr. Stanley makes slight allusion to four such cases. In general, however, the pulsation of osseous tumours does not result from their structure, but is owing to their being so situated, as to receive and transmit the impulse of an artery or arteries, as was the fact in some interesting cases recorded by Dr. Cumin. Mr. Stanley refers to a case of his, where a tumour on the humerus pulsated strongly ; the walls of the tumour were about half an inch thick, composed of firm gelatinous matter, forming a cavity, which contained serous fluid. He also states, that there are fourteen cases recorded of bony tumours contiguous to a large artery, the walls of the bone being absorbed to such an extent that the impulse of the artery might readily be communicated to the whole mass. For further information on morbid growths, see Exostosis and Tumours.

Spina ventosa is a term which has been applied to every known form of osseous morbid growth ; but its meaning is so indefinite that its use is here laid aside.

Hydatids are occasionally met with in bone. There are three preparations in the museum of St. Thomas's hospital quite sufficient to prove this. In one they exist in the spinal column ; in another, the cancelli of the head of the humerus have become absorbed, the compact structure expanded, and the tumour thus formed contained hydatids, several of which are preserved in a bottle. In the third case there is abscess of the femur and tibia containing hydatids. In the Hunterian museum at Glasgow is a femur, the lower extremity of which contains hydatids, several of which may be seen lying in the bottom of the jar.

Mr. Keate has given a minute description of a case in the tenth volume of the Medico Chirurgical Transactions, in which hydatids were formed in the lower part of the os frontis. Various operations were performed with a metacarpal saw, by which the inner table of the cranium was completely exposed, and lint, soaked in a strong solution of sulphate of copper, was applied. Caustic potass, arsenic, and nitrate of silver, had also been applied to cells in the compact bony texture. Complete and permanent recovery followed.

V. Bone is subject to malignant diseases, or in other words, it becomes the seat of morbid deposits, which do not resemble any of the primary tissues of the body in physical characters, or organization. By these deposits the osseous tissue is gradually destroyed, or transformed into the morbid structure ; adjoining tissues are successively attacked and destroyed ; and the lymphatics and neighbouring glands become implicated. Mr. Mayo remarks, that " when new formations appear in bone, with the local characters of malignant disease, they have not the same rootedness in the system as when they originate in the soft parts ; so that the removal of a bone attacked by malignant disease is not in general followed by a return of the complaint." This, however, must be received with some limitation ; for even putting aside the probability that the deposit in the bone may be but the local evidence of a disease affecting the whole system, Sanson has shown that osteo-sarcoma returns with great rapidity, if only part of the bone affected have been removed. Suppose the lower extremity of the humerus, for example, to be attacked by osteo-sarcoma, and the bone be amputated in its centre, the disease will very speedily return, even though bone, apparently healthy, existed between the tumour and the place of amputation. The practical rule, therefore, should be always to remove the whole bone, by amputating at the joint above the disease, or the bone beyond it.

For malignant exostosis, and osteo-sarcoma, see Cancer, Exostosis, Osteo-Sarcoma.

The able author of the article, "Pathological Conditions of Bone," in the Cyclopædia of Anatomy and Physiology, inclines to the opinion that cancer and fungus hæmatodes are generally, if not always, propagated from adjacent parts or structures. In many of Cruveilhier's plates, however, the deposit appears in the centre of bones, their walls being unaffected; and there are four similar specimens in the museum of St. Thomas's hospital. Two of these are described as scirrhous tubercles in the spinal column, and any one may convince himself that they were primarily deposited in the situations they fill, and are not the effect of extension of neighbouring disease. The other two are described by Sir Astley Cooper in his Lectures[1], as scirrhous secretion into the sternum and thigh-bone. The bones were taken from a lady, whose femur broke as she was rising from bed. Scirrhous tubercles were also found in the integuments covering each breast, in the glandular structure of the breast itself, and in neighbouring absorbent glands; also in the substance of the pectoral and intercostal muscles, on the pleura of each side, and on the pericardium; in the substance of the lungs, liver, pancreas, mesenteric glands, and uterus. Here then we see the bones participating with the soft parts in the effects of a general disease, but not affected by contiguity or continuity of tissue.

Medullary sarcoma, or fungus hæmatodes, are terms applied to a malignant disease of bone, generally arising in the cancellated structure, causing irregular expansion of the compact texture, from the increased deposition or formation of matter resembling brain, coagulated blood, or both combined. The symptoms are swelling, increasing very rapidly, acute pain, a varicose state of the superficial veins covering the tumour, the surface of which is irregular, in some parts unyielding, in others soft, and other parts again give a crackling feel like parchment. Ulceration of the skin takes place, and a soft bleeding fungus shoots forth. These signs, with the general appearance of the patient, which is characteristic of the cancerous diathesis, are sufficient to establish a diagnosis as to the nature of the disease. See Cancer.

Melanosis is occasionally seen in bone. In the museum of St. Bartholomew's hospital are three specimens of bones so affected, which were taken from a person in whom melanotic matter was found in other organs. There were also two such preparations in Mr. Langstaff's museum.

Some of these malignant growths doubtless arise from the medullary membrane, others in the proper osseous tissue. The periosteum is also the seat of a malignant tumour called fibro-sarcoma, which is dense, fibrous, and white, or straw-coloured. It frequently forms on the cranial aspect of the dura mater. Louis relates a case in the fifth volume of the Mémoires de l'Académie de Chirurgie, in which a fungous tumour of the dura mater produced destruction of the temporal and parietal bones in a child two years old. Similar cases are recorded by Walther in Graefe's Journal. See Dura Mater.

Mr. Mayo mentions that Mr. Sweatman has a specimen of scirrhous periosteum, which was taken from a patient who had cancer in the breast. "The dura mater, and pericranium, and orbital periosteum, for a considerable extent on the affected side of the head, were found to be thickened and hard; the dura mater was at one part a third of an inch in thickness; the arachnoid adhered to it, and partook in the same thickening. The bone is not diseased, but is something more vascular than usual." Several preparations showing partial and general thickening of the dura mater and pericranium may be seen in the museum of the College of Surgeons.

This article is to be considered as a mere sketch of an important subject, simple and interesting in itself, but which has been rendered complicated and abstruse by the majority of those who have written on it.

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(*Thomas Spencer Wells.*)

BONE-KNIPPERS; *tenacula*, Lat. *tenailles incisives*, Fr. An instrument for cutting off portions of bone or cartilage. It is formed like a forceps, with strong handles and edges that cut clean when brought together.

BOTTINE, (*ocrea levior,*) a name given by French surgeons to a machine shaped like a boot, and furnished with straps, springs, buckles, and pads. It is employed to correct or prevent deformities of the inferior extremities in children.

BOUGIE, (*candelula, virga cerea*, Lat.; *δαδίον*, Gr.; *Wachskerze*, Ger.) literally, a waxen rod or candle. In surgery this word is used to designate long, slender, polished, and generally flexible instruments of a cylindrical shape, which are employed in the cure of diseases of the urethra, and of the other mucous passages of the body.

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[1] Vol. ii. pp. 184—189.

The invention of this instrument dates as far back as the year 1551, and is attributed by Andre Lacuna to Philippe, a Portuguese empiric, who communicated to him the secret of their composition. Three years afterwards, however, Amatus, who knew Philippe well, claimed the honour of the invention for Alderetto of Salamanca; he himself having taught the use of the bougie to Philippe. Alphonso Ferri of Naples disputed this claim in 1553, asserting not only that he had been in the habit of using this instrument from the year 1548, but that the escharotic ointment of which he made use on those occasions, had been known to Alexander of Tralles, who flourished in the sixth century. He also speaks of other means of exploring the urethra, such as cylinders of lead of various sizes. That such applications should have been proposed as something new about this period, although previously known, is extremely probable, when we consider that urethritis presented itself as a new disease about the same time. These bougies were at first made with thread or cotton wicks, dipped in wax; and as they were employed in the cure of what in that day were called caruncles or carnosities of the urethra, the escharotic used for this purpose was worked into the side of the bougie at the point which it was supposed would come in contact with the carnosity. A great variety of irritating substances were had recourse to for this purpose; savine powder and cerate formed one of these escharotics; another consisted of a dram each of vitriol, orpiment, alum, and verdigris, macerated in vinegar, and then incorporated with two ounces of unguent. cerussæ; and Riviere relates that Charles IX. was treated by an Italian empiric named by Giannati, by means of a preparation of antimony, tutty, cerussa, camphor, opium, and some other substances of a less active nature. The composition of Daran's bougie, which for the greater part of his life he had kept a secret, is still more singular: his receipt for it runs thus:—Take of olive oil two pounds, red-wine half a pound, a young live pigeon plucked, or in its stead, half a chicken; boil in an earthen vessel till the wine is evaporated, then dissolve with what remains four ounces each of yellow wax and burgundy pitch, two ounces of spermaceti, one ounce of diabotanum, and from two drachms to two ounces of burned sole-leather, in powder. This mixture is spread on linen, which is cut into straps of different sizes, and rolled to form bougies.

While the idea continued to be entertained, that they were employed to destroy imaginary carnosities, great importance was attached to the composition of those instruments, and the good effects of pressure, for which they are now most valued, were naturally overlooked; but these once recognized, the mechanical properties of the bougie became the chief object of consideration, and the escharotic bougies fell very properly into disuse. Accordingly we find at a later period the manufacture greatly simplified. The bougies employed in Guy's Hospital about the middle of the eighteenth century, were made with old diachylon plaister one ounce, two drachms of mucilage plaister, and one of white precipitate. This preparation was spread on linen, which was cut into small bands, and rolled into a conic shape.

Other substances were also employed in the manufacture of these instruments, such as the slender stalks of various plants, parchment, or mouse-skin enveloping copper wire, glass, horn, whalebone, ivory, and gut. Bougies of the last mentioned substance are still in common use, and they possess some advantages, as they are capable of being made of exceedingly small diameters; and when enveloped with a very thin coat of goldbeater's skin, are perfectly smooth; their flexibility also in the small sizes is of great use; by being allowed to remain for some time in the urethra, they imbibe moisture, and swell; a circumstance which, with proper management, may be turned to good account in the treatment of stricture. In cases of this nature, where the occlusion is nearly complete, they answer admirably the purpose of quickly preparing the way for bougies of a larger size, and of different quality. The pointing them is a process of some nicety, and is performed with a small sharp knife, and the pumice stone or file. Mr. Ure has recently recommended the ivory bougie, softened by the removal of its earthy constituents. This bougie, which he has made trial of, at the suggestion of Dr. Güterbock of Berlin, is slightly elastic, and so tough, that it cannot be broken. Before using it, it should be immersed in water for several hours.

The bougies now in ordinary use, are made with diachylon that has been kept for some time, and mixed with a quarter of its weight of wax, and a certain quantity of olive oil, to which some needlessly add, a small proportion of mercury, sulphuret of antimony, or red oxide of lead. Long triangular slips of linen are dipped in this mixture, and rolled into form, they are then polished on porphyry in the usual way. A better method, however, consists in enveloping the composition with the prepared linen in spiral folds, and polishing as before; in this way they may be made in any shape required.

The advantage of being able to draw off the urine, at the same time that the urethra was subjected to the dilating effect of the bougie, suggested the necessity for making them hollow, or tubular. In the year 1779 Bernard, a silversmith of Paris, presented instruments of this kind to the Royal Academy of Surgery, which were unquestionably a very important improvement upon the bougies then in use. Zeden of Berlin, and Pickel of Wurzbourg laid claim to the invention, but without being able to substantiate it, as their attempts were made with elastic gum, while Bernard employed a better and cheaper substance, viz. linseed-oil, which he caused to thicken over a slow fire. Even now, the so-called gum elastic bougies are made by coating several times in succession, the silken, or linen, or cotton tube with the oil thus prepared, the bougie, when dry, being polished on porphyry.

These bougies are also made solid, in order to obviate the too great flexibility, for which, particularly in the smaller sizes, the hollow ones are sometimes remarkable. They are made in a great variety of shapes, conical at the end, bulbed at the middle, &c., according to the nature of the case for which they are intended. The author of this paper has had them prepared at Savigny's of the same shape as his self-guiding catheter, and he finds them answer the purpose as well as the silver instrument.

At the commencement of the present century Mr. Smyth introduced a new kind of bougie, composed of a flexible alloy of the white metals; these have been since very much improved: they are susceptible of a fine polish, are easily kept clean, they answer the purpose very well, especially in the higher numbers, and may be made either hollow or solid.

The old bougies, prepared with catheretic or escharotic substances long since laid aside, and the armed bougie of more modern date, have given place to the port-caustic, an instrument by which the nitrate of silver (the substance most generally employed) is brought with the nicest precision into contact with the morbid growth. The description of this instrument, together with that of the exploring bougie, will be found in the article which treats of strictures of the urethra.

The sizes of bougies are designated by numbers augmenting from 1 to 20, or 24. The indications thus given, however, are uncertain, as the standard varies in almost every manufactory. The inconveniences hence arising are by no means inconsiderable in respect to description, and it would, therefore, be very desirable to have some fixed measure of graduation. This could be very easily established by taking half a line for unity, and augmenting half a line for each ascending number. The length of these instruments varies from ten to twelve inches, and the outer, or manual extremity, is headed with sealing-wax, ivory, or a flat bone handle.

The history of the bougie, like that of many other instruments employed in surgery, contains the history of the improvements that have taken place during the last century in this department of the art. "The bougie, with its application," says Hunter, "is perhaps one of the greatest improvements in surgery which these last thirty or forty years have produced. When I compare the practice of the present day with what it was in 1750, I can scarcely be persuaded that I am treating the same disease. I remember, when about that time I was attending the first hospitals in this city, the common bougies were either a piece of lead, or a small wax candle; and although the present bougie was known then, the due preference was not given to it, nor its particular merits understood, as we may see from the publications of that time."

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(W. B. Costello.)

BRAIN, see HEAD.

BRONCHOCELE, see GOITRE.

BRONCHOTOMY, (*Luftröhrenschnitt*, Ger.) This term is derived from *βρόγχος*, the windpipe, and *τέμνω*, to cut; and, therefore, includes the operations of Laryngotomy and Tracheotomy. The operation consists in making an opening into some part of the air tubes, in order to admit air into the lungs, for the purpose of freeing the patient from the effects of obstructed respiration; or for the removal of foreign bodies.

I shall first give a sketch of the history of the operation; then consider the various circumstances under which its performance may be required; and, lastly, detail the mode of operating [1].

History.—The earliest account we have of the application of mechanical means for the relief of symptoms depending on impeded respiration, or rather the first recommendation for such application, is found in the third book of Hippocrates, "De Morbis," supposed to have been written about four hundred years before Christ. The following extract is a literal Latin translation of the remarkable passage, in which this recommendation is given: "Ex angina dicta homo suffocatur, et fauces magis occupare videtur, ut neque salivam, neque aliud quicquam deorsum trahat, oculi affecti sunt, ac velut eis qui strangulantur prominent, et per eos contentè intuetur, neque eos conuertere potest, crebro se jactat et exilit, facies et fauces incenduntur, ac etiam collum. His verò qui vident nihil mali habere videtur, et visus et auditus hebescit, nihilque præ suffocatione intelligit, neque quid dicat, aut audiat aut faciat, sed jacet ore hiante salivam effundens . . . . . . Quin et per medicamentum aut infusum deorsum purgare oportet, *fistulæque in fauces ad maxillas intruendæ, quo spiritus in pulmonem trahatur, efficiendumque ut quam citissime spuat, pulmoque extenuandus.*"

Celsus does not allude to this passage, but after stating in the fourth chapter of his fourth book, that scarification is to be employed for the relief of angina, says, "Quibus si non fuerit æger adjutus, scire licet a malo victum esse."

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[1] The practical part of this article formed the Prize Essay of the Dublin Medico-Chirurgical Society, for 1839; and was read before the society, April 27, 1839.

Pliny in the third chapter of the twenty-sixth book of his "Historia Naturalis," written between A.D. 23 and 79, and the Latin Editio Princeps of which was printed in Venice in 1469, says, "In quibusdam morbis medendi cruciatus detraxit, ut in anginis, quas curabant in fauces organo demisso."

A.D. 131—201. Galen is the first who directly mentions the opening of the air-tube, and he evidently regards Asclepiades as the inventor of the practice, stating: "Asclepiades ultimum auxilium posuit, in iis qui maxime suffocantur, laryngem incidere[1]."

Cælius Aurelianus speaks slightingly of the operation in these terms, "Est etiam fabulosa arteria ob respirationem divisura, quam laryngotomiam vocant, et quæ a nullo sit antiquorum tradita, sed caducâ atque temerariâ Asclepiadis inventione affirmata[2]."

Aretæus in the seventh chapter of the first book of his work, "De Morbis acutis et diuturnis, eorumque curatione," says, "Quicumque strangulationem ab anginâ verentes, quo luxius spiritus duceretur, arteriam secuerunt, non sane experimento rem comprobasse videntur." He thought that inflammation would be excited by the operation, and that even if strangulation were thus warded off, the parts being cartilaginous would not heal. There has been a good deal of controversy as to the time at which Aretæus wrote. The Editio Princeps of the original Greek was published in Paris in 1554.

Oribasius, who was physician to Julian the Apostate, and wrote his Collections about the year 360, speaks of the operation, and some cases to which it was applicable.

Paulus Ægineta describes the operation after Antyllus, an author whose remaining works are very scarce. He states that the practice is useless where the lungs are affected; but when the inflammation lies about the throat and tonsils, the experiment is very rational, to prevent the danger of suffocation. He says Antyllus knew when the trachea was opened by the rushing out of the air, and the loss of voice. There is a long passage to this effect in the thirty-third chapter of the sixth book of his "De Re Medica," the best edition of which was published in Venice in 1528. Paulus is placed in most biographical dictionaries in the fourth century; but Abulpharagius, who, according to Friend, has left the most accurate history of those times, places him in the reign of Heraclius, about the year 621.

Avicenna[3] recommends the employment of bronchotomy in angina, and shows the mode of its application. A.D. 980—1036.

Avenzoar recommends bronchotomy in cases of desperate quinsy. He describes it as a difficult operation, which he had never seen performed, but states that he opened the trachea of a goat, and dressed the wound with honey-water, which soon effected a cure. He was an Arabian, and wrote towards the close of the eleventh century.

Albucasis, a celebrated Arabian surgeon, describes the operation after the manner of Paulus. He says he never saw it done, but does not regard it as dangerous, because he saw a woman who opened the windpipe in an endeavour to commit suicide, but the blood-vessels being uninjured he soon cured her. He lived about the year 1085, and his works were collected and published in Venice in the year 1500, under the title "Chirurgia, seu de Methodo medendi per Chirurgiam." In the forty-third section of the second book, headed "De incisione laryngis, ob tumorem in interno gutture ortum," he says, "Illorum vero omnium quibus est tumor in ore calidus, aut in gutture, aut amygdalis, quum non sit morbus in fistula ipsa, necesse est uti laryngis sectione, ad exitium a suffocatione evitandum."

In 1363 Gui de Chauliac speaks of bronchotomy, especially referring to Avicenna. He says, "cynanches vehementiores fiunt, et non valent medicinæ, et creditur quod perditio futura sit, illud per quod speratur evasio est scissio cannæ[1]."

In 1541 the celebrated commentaries of Antonius Musa Brasavolus, a distinguished physician at Ferrara, were published, under the title "Commentarii et Annotationes in viii libros Aphorismorum Hippocratis et Galeni." In the commentary on the fourth book of Hippocrates he states, that he "propriis manibus" opened the trachea in a patient on the point of death from quinsy, and thus saved life. He states also, that he had done it in other cases with similar success, as does Benivenius[2].

The subject of bronchotomy was very well treated by Gulielmus de Saliceto in his Chirurgia, published at Venice in the year 1546. In 1561 the first edition of the works of Ambrose Pare was printed. The twenty-ninth chapter of the ninth book contains accounts of three cases where persons recovered after severe wounds of the trachea. It was not till these cases, and others by Nicolaus Florentinus, and Jacotius, were fully known, that the Hippocratic notion of cartilage being incapable of uniting was completely overcome.

In the year 1600 Casserius of Placentia published his work, "De vocis auditusque organis Historia Anatomica, &c." The twentieth chapter of the first book is entitled "De Laryngotomia." He treats the subject rather fully, and describes the steps of the operation, which are shown in his twenty-second plate.

Thomas Fienus, professor of medicine at Louvain, and physician to the Elector of Bavaria, wrote his work on the principal controversies of surgery in 1602. In his fourth book he describes the section of the trachea, but says, "Est autem hoc remedium periculosum, et ideo non licet eo uti, nisi in deploratissimo casu." Not only this idea, however, but the very words are borrowed.

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[1] In Medico, cap. xiii. edit. Chart. tom. ii. p. 379.

[2] De Acut. Morb. lib. iii. cap. iv.

[3] Lib. iii. sec. 9. cap. 11.

[1] Lib. iii. tract. i. cap. 11. in the Latin edition of his work, published at Venice in 1608.

[2] De Abdit. Morb. cap. 88.

In 1617 the Opera Chirurgica of Fabricius ab Aquapendente were published at Padua. In his forty-fourth chapter, after quoting Rhazes, Avicenna, Avenzoar, and Hali Abbas, he says the surgeons of his time feared to undertake the operation, "Et ego quoque eorum vestigia secutus, nunquam administravi."

In 1620 Habicot published a small treatise, entitled, "Question Chirurgicale par laquelle il est démontre que le Chirurgien doit assurément practiquer l'opération de la Bronchotomie, vulgairement dicte Laryngotomie, ou perforation de la flûte ou tuyau du poulmon." He gives some interesting cases, which will be hereafter referred to.

In 1617 Joannes Agricola recommended a division of the cartilaginous rings of the trachea, when there was so much swelling from quinsy that neither food nor air could pass.

Rodericus a Fonseca, in his Consultationes Medicæ, published at Venice in 1628, after alluding to some species of quinsy, and their treatment, refers to bronchotomy, and remarks, "Est enim remedium unicum, ad quod confugiendum est in his casibus, nec periculosum ut apparet."

The ep. 81. cent. 1. of the "Epistolarum Medicinalium cent. prima et secunda," by Bartholinus, a Danish physician, is from Rene Moreau, dated 1646. The writer states that he performed bronchotomy twice, and permanent recovery followed. Spigelius is also stated by Bartholinus to have favoured the operation.

The celebrated Armamentarium Chirurgicum of Scultetus was published at Ulm in 1655. In this work the operation is described very fully, and illustrated by plates. Lamzwerde, in his commentary on this book, says, "Aspera arteria in affectibus laryngis qui suffocationem minantur, chirurgo anatomiæ non ignaro tutissime perforatur."

About this time the operation was warmly advocated in Italy by Severinus of Naples; successful cases were also recorded by Serrier, Muys, and Dekkers.

A work by Purrmann, translated from High Dutch, was published in London in 1706, entitled "Chirurgica Curiosa; or, the newest and most curious Observations and Operations in the whole Art of Chirurgery." In this work Purrmann says, that he himself performed bronchotomy in a case where there was great swelling and inflammation about the throat, threatening sudden suffocation, the voice and intellectual faculties being gone. Immediate relief followed. The operation is strongly recommended, and cases given in Garengeot's Traité des Opérations de Chirurgie, published in Paris in 1720.

The next step was the publication of Detharding's "Dissertatio de methodo subveniendi submersis per laryngotomiam," in 1714.

In the volume of the Philosophical Transactions for 1736, is a letter from Dr. Martin, narrating a case in which on account of sudden and violent symptoms depending on acute disease about the glottis, bronchotomy was performed at St. Andrew's with complete success. In the same letter it is stated that Mr. Baxter, of Cupar in Fife, and Dr. Oliphant of Gask, Perthshire, had also operated with success.

In Heister's Institutiones Chirurgicæ, published in 1739, is a chapter entitled, "De Bronchotomia, Laryngotomia, seu Tracheotomia," in which he states that the operation has been performed on account of inflammation: to remove foreign bodies: and for the recovery of drowned persons. He regards the space between the second and third rings of the trachea as the best situation to operate for the removal of foreign bodies. He describes the operation in this way, and also when rendered necessary by angina, both by incision and with a trocar, and illustrates it by plates. He shows expressly the danger of delaying too long, and refers to the work of Detharding.

In 1746 the celebrated memoir of Louis was published in the memoirs of the French Royal Academy of Surgery; and since that time cases and essays multiply upon us. We find them in Van Swieten's Commentaries, 1752; Journal de Médecine, Dec. 1765, and July, 1772; in several volumes of our own Medico-Chirurgical Transactions, and other periodicals. We have then the excellent paper of Mr. Lawrence, in the sixth volume of the Medico-Chirurgical Transactions, and Mr. Porter's well-known work written expressly on this subject.

I have thus endeavoured to give a sketch of the progress of opinion with regard to this operation, from the earliest ages of surgery to our own times, and shall now proceed to consider the propriety of its performance under the subjoined heads.

I. When foreign bodies have entered the windpipe.

II. In acute diseases of the windpipe—idiopathic—traumatic—and functional.

III. In chronic diseases of the windpipe.

IV. In cases where tumours in the larynx itself, or in the neighbourhood, obstruct the passage of air, either mechanically, or by exciting spasm of the glottis.

V. In injuries and wounds of the throat, and their consequences.

VI. In cases of suspended animation.

I. When foreign bodies have entered the windpipe.

If there be any case where the propriety, or absolute necessity of the performance of bronchotomy is undoubted, it is when a foreign body has entered the air tube. The only objections that can be advanced are, the chance of the expulsion of the body by expectoration —the fact that persons have lived for many years, the body remaining — and Desault's opinion in favour of the introduction of an elastic tube through the nostril into the pharynx, as will be hereafter described. In answer to the first, if we reflect on the mode in which a body enters the larynx, we shall see that its expulsion per vias naturales is highly improbable, although certainly some rare cases have been advanced in which it has taken place. (For instance, Nooth gives a case where a leaden shot was expectorated: Hochsteten, a Portugal ducat: Howship, an iron nail: and Abercrombie, a tooth.) The organs of deglutition are so formed, and their vital endowments such, that no substance can pass into the air passages in simple swallowing, and accordingly we find that this accident occurs, either when a full inspiration is taken, some loose body being in the mouth, or when from haste in eating, the actions of inspiration and swallowing are combined. Now the rima glottidis being enlarged during inspiration, and contracted during expiration, it is obvious that a body may readily enter the larynx, and its expulsion be prevented by the diminished diameter of the rima:—further, it could hardly approach the glottis, without producing violent cough, during which the rima is still more contracted:—again, if the body be irregular, the chances are against its being propelled in exactly the proper direction:—and, lastly, there is very great probability of its becoming entangled in the larynx. These considerations apply with peculiar force against the employment of therapeutic means to effect the expectoration of the body; even in the most chronic cases, errhines, emetics, &c., are at the best useless, and in recent cases they must be dreadfully hazardous. A sudden convulsion may kill the patient, while we are waiting for their action; or the paroxysms of cough they excite be so intense, that congestion of the brain, or rupture of the air-cells are probably produced: or the patient is so much convulsed that the successful performance of the operation is rendered almost impossible. In answer to the second objection, the patient is liable at any time to sudden suffocation from the foreign body becoming entangled in the rima during a fit of coughing: to apoplexy or convulsions from derangement in the cerebral circulation, owing to violent cough; and to emphysema of the lung from the same cause: to chronic bronchitis and its effects: to acute pneumonia: the formation of pulmonary abscess: to hæmoptysis: or they die with consumptive symptoms arising from the protracted irritation. Again, even if the foreign body be expectorated, recovery by no means invariably follows, the patient dying either of the injury the brain has suffered, or the effects produced on the lungs and general system. Of seventeen cases collated by Dr. Stokes, in which the body was expectorated, one patient died after many months with abscess of the left lung: in another death soon followed the expectoration: in another the body was expectorated after two years, but death ensued with symptoms of phthisis: in another, it was expectorated after thirty-one months, but the cough and expectoration continued, great susceptibility to bronchitis, hæmoptysis supervened, and death in the early part of the fourth year from the accident: in another it was expectorated after seventeen years, but hectic and emaciation followed, and death in a year and a half afterwards. Of ten who recovered, in one the body remained fifteen years, in another seven, in another two and a half, in another four months, but the patient remained for many years subject to pain, cough, and hæmoptysis. As to Desault's proposal, it must be remembered that the distress of the patient in general arises not from obstruction to the passage of air, but from the irritation of the foreign body, exciting some of the evils just enumerated, or spasmodic action of the laryngeal muscles. Either of these evils, his tubes are calculated to increase. If mechanical obstruction cause the distress, and the body be impacted in the larynx, the passage of a tube is likely to be mischievous, by forcing the substance through the delicate structures, or by exciting a cough, which may throw it into the rima, and instantly kill the patient. If the body be in one of the bronchi, Desault's tubes evidently cannot remove it, and its removal is the only way to remove the obstruction it produces.

I am aware that at the last meeting of the Royal Medico-Chirurgical Society, during the discussion on a paper by Mr. Travers, jun., several members opposed the performance of bronchotomy for the removal of foreign bodies, chiefly on the ground of their occasional expectoration. But as I have shown that recovery by no means invariably follows such expectoration, even if it do occur, and as I have never met with, or read of a case, where death did not ultimately result from pulmonary disease apparently connected with the protracted irritation of the extraneous substance, it appears evident that when a foreign body has entered the windpipe, the sooner bronchotomy is performed the better; and no delay should take place on account of the little distress the patient may at the time be suffering, for the attacks of dyspnœa, &c., are at first intermittent, and it is not uncommon for a child soon after the paroxysm to appear perfectly well, cheerful, and playful. But as the irritation becomes permanent, we have those symptoms, which some suppose necessary to justify the operation, arising from the inflammation which has been set up, and which even the removal of the cause may be too late to check. But before proceeding to operate, the surgeon must be convinced of the existence of the foreign body in the tube. It may have lodged in the pharynx, or œsophagus, but of this he can soon satisfy himself by the introduction of his finger, a bougie, or probang; and its presence in the air tube may be discovered by the symptoms, and physical signs. The symptoms will vary, 1st, with the sensible and chemical properties of the body; thus a small smooth substance will produce far less distress than one pointed, rough, or irregular; and 2ndly, according to the portion of the mucous membrane to which the body is applied, that of the trachea being far less sensible than that of the larynx. The history of the case is often so clear that but little examination is necessary to show the nature of the accident, but in others it is very obscure. If it be in the larynx we should expect almost incessant harsh, dry, spasmodic cough; respiration, according to Dr. Stokes "croupy," but Mr. Porter says, "always imperfect, but never loud or stridulous, as in acute cynanche trachealis:" pain, increased on pressing the larynx, and paroxysms threatening suffocation: the face becomes purple, cheeks swollen, eyes protruded, and a stream of frothy saliva flows from the patient's mouth during his struggles. If the body be moveable, there are intervals of comparative, often of perfect ease, but paroxysms are again induced on its being drawn either into the larynx, or into one bronchus.

To distinguish these symptoms from those of laryngitis, we have their sudden occurrence in a person previously healthy, or at least not suffering from any pulmonary disease. We remark that in laryngitis the sympathetic fever occurs previously to, or simultaneously with the local symptoms, but when from a foreign body, not until much irritation has been excited. In laryngitis there are none of those *complete* intermissions to the paroxysms, which occur when a foreign body produces the symptoms, for though there are partial remissions, some stridor always persists.

Lastly; in laryngitis the difficulty of breathing is in inspiration; but in the accident, in expiration.

The last observation will also serve to distinguish the case from one of spasmodic croup.

We have the exposure to contagion, previous catarrh, and the peculiar hoop, to distinguish it from hooping cough. In this affection, the difficulty of breathing also occurs in inspiration.

These considerations will render the nature of the case pretty evident, and by the aid of physical signs we can make assurance doubly sure. The right bronchus being the larger, and more directly continuous with the trachea, is that into which the foreign body almost always passes. It may close this tube either completely or partially. If the obstruction be complete, both sides of the chest are clear on percussion, but in the right lung the respiratory murmur is abolished; in the left it is puerile. If the obstruction be partial, we hear the respiratory murmur, diminished in proportion to the degree of the obstruction. In applying this test, however, it is necessary to remember that the murmur is naturally a shade weaker in the right, than in the left lung, therefore the difference, to be valuable, must be considerable. These signs will be permanent if the body retains its situation, but if it be moveable, we have the sudden reappearance of the respiratory murmur when it passes up into the windpipe, and then laryngeal irritation is excited. The murmur is again abolished on the body resuming its former situation. This occurs in no other affection of the lung.

The physical signs are more obscure when the body remains in the larynx or trachea; but then we have the signs of irritation (sibilous and sonoro-mucus rales) spreading from above downwards, not preceded by constitutional irritation, and occurring suddenly in a healthy person.

There are also other signs, in themselves pathognomonic of the accident. In a case related by Mr. M'Namara, he says, "I could distinctly perceive that there was a mechanical obstruction to the exit of the air, produced by the ascent of the foreign body to the larynx, causing a perfectly audible sound, which resembled more that produced by striking the tongue forcibly against the anterior part of the hard palate, when the mouth is closed." In another case of his, a boy had a plum stone, with a hole in it, in his trachea, which he could whistle through. Mr. Liston says, "a peculiar noisy characteristic rale is perceived on applying the ear, and a shock like the shutting of a valve can be thus appreciated, or even by the finger placed on the box of the larynx, when the foreign body, by the forcible expiration, is made to strike the rima." Mr. Porter says, "when the substance is loose, it is frequently in its motions upwards and downwards within the tube heard to strike against its walls with a peculiar rattling sound. This is heard to most advantage, when the patient makes a forced expiration, and the foreign body is drawn up towards the larynx."

A few months since a case occurred in St. Thomas's Hospital of a boy into whose air passages, a fourpenny piece had entered. It lodged in the right bronchus, and I am told by some gentlemen who examined the chest, that a peculiar sound was heard, produced by the passage of air on each side of the metal, which gave an exact idea of the nature of the case.

I have seen cases, however, where all the effects of a foreign body in the larynx, were produced by causes a little out of the usual course, and in the first the symptoms were so severe that actual suffocation was dreaded. A schoolboy was gaping at the dinner-table, when another threw a spoonful of salt into his mouth, some of which entered the larynx. The most violent spasmodic cough immediately ensued, and he seemed for some time in great danger. The other case was that of a druggist's apprentice, who was powdering euphorbium, without due care. A little of it appeared to have entered the glottis, for very similar effects were produced to those just stated. The obstruction in these instances being confined to the top of the tube, it being, as I conceive, produced wholly by spasm of the glottis, they would be peculiarly favourable for the successful performance of bronchotomy; and if other means failed, no surgeon would be justified in neglecting to operate.

Having determined, then, that there is a foreign body in the air tube, the surgeon should endeavour to ascertain its size, form, situation; also, whether it is loose or fixed. Its situation may be evinced by local pain, but this is not always present, even though the form and nature of the substance render it irritating. These particulars may serve to modify the operation in some degree, but it should be immediately performed, in the manner to be hereafter detailed.

II. In acute diseases of the windpipe. 1. Idiopathic.

1. *Acute laryngitis.*—In this disease bronchotomy has been both frequently recommended, and successfully practised. But as some say it is not be performed till every other remedy has failed; others insist on the danger of regarding it as an ultimum remedium, and Dr. Baillie gives a fixed time for its performance; it may be well to consider the circumstances under which it is indicated. The general symptoms of laryngitis are dyspnœa on *in*spiration,—stridor more audible at a little distance from the patient than with the stethoscope,—the voice very hoarse, or reduced to a low whisper,—harsh and spasmodic cough,—often pain in the region of the larynx, much increased on swallowing, with violent symptomatic fever, and probably no signs of disease in any other part of the respiratory system. These effects are produced either by the mechanical obstruction caused by the congested state of the mucous membrane, or by irritation exciting spasm of the glottis. Bronchotomy, by allowing the free passage of air, affords immediate relief, and by bringing the inflamed part to a state of rest, removes one great obstacle to the successful treatment of the disease. It should not be undertaken, however, till it appears that notwithstanding the free use of the lancet, calomel, opium, &c., the stridor is severe and increasing, and the other symptoms, especially the condition of the surface, contra-indicate further depletion. Dr. Baillie's rule, to wait thirty hours to try the effect of bleeding and opium, appears injudicious, as it would be madness to delay the operation when asphyxia is imminent: and, on the other hand, rash to operate if the face and lips continued of a good colour, the surface warm, and no symptoms were present indicating cerebral congestion, or threatened asphyxia.

We may say, then, that bronchotomy should be performed early in the disease; but not until bleeding, &c., has had a fair trial, unless we are called in at such a period of the case when suffocation is threatened, and it is too late to commence with the usual treatment. If it be delayed too long it will be useless, and only tend to bring disgrace on the operator and the operation itself. If we find the patient becoming exhausted, his voice failing, dyspnœa and cough increasing, the blood imperfectly arterialized, face and lips livid, eyes projecting and watering, further depletion or delay would be highly reprehensible, and the operation should be immediately performed, as it affords the only reasonable hope of safety.

So much for pure laryngitis. The operation would be improper in a case complicated with extensive bronchitis, and effusion into the tubes. But it does not follow that even the coexistence of important pulmonary disease should absolutely forbid its performance, though it should, of course, materially influence the prognosis. For though a perfect cure may be next to impossible, the operation will probably greatly mitigate the distress and prolong life for some days, or even weeks, which in many cases would be of the greatest importance.

(2) *Acute cynanche trachealis: croup.*—Much has been said in favour of bronchotomy in this disease, and cases have been recorded where it was performed with complete success. In one of Mr. Chevalier's cases it was successful, though the countenance was livid, cold sweats came on, and the patient was rapidly sinking. Mr. Chevalier thinks that the effusion of lymph is seldom sufficient to produce suffocation, which he supposes is owing to the accumulation of mucus superadded, preventing the patient from emptying the branches of the bronchi in coughing: and that the operation is useful by enabling the patient so to cough as to empty them. Louis has pointed out the danger of regarding the operation as an extreme measure, and thinks its performance ought to be a general practice. Sir C. Bell also favours it, on the ground that the lymph acts as a foreign body in occasioning spasms of the glottis, consequent obstruction of the passage, and confinement of the mucus. Michaelis advised its early performance as a convenient mode of removing the effused lymph. Lastly, Bretonneau has proposed the operation for the purpose of making topical applications to the affected surface. He narrates cases where recovery followed this plan; but Dr. Stokes believes the recovery should be attributed to the gradual decline of the disease, in a patient whose immediate death was prevented by tracheotomy.

On the other hand, Dr. Cheyne has urged, that the existence of the false membrane in the larynx is not in general the cause of the patient's death; and he has proved by dissection, that in many cases a space is left for a current of air sufficient to support life. He also thinks the operation unadvisable, because when the membrane of croup fully formed is expectorated the disease is generally fatal, even when all the benefits of the operation have been thus obtained. A very strong objection may be founded on a statement by Goelis, who after having made forty-three public dissections of children who had died of croup says, "pseudo-membranæ sedes variæ partes tracheæ et bronchiæ sunt, majorem nunc, minorem eorum partem tenet, quin immo per tracheam integram et bronchia ad minimas usque ramificationes extenditur." Mr. Porter strongly insists that it should very seldom be performed in croup. Dr. Copland says, there is not a chance of its success after general treatment has failed. And Dr. Mason Good says, it should never be attempted till all other means have proved inefficacious.

The question, then, is—Is bronchotomy ever to be performed in croup, and if so, when?

In the first stages of the disease, when active antiphlogistic measures are indicated and likely to prove useful, it is not to be thought of. The irritation it would excite must increase the disease, and it could do no good before the lymph was effused, In a more advanced period, when lymph has formed, it must be generally improper, for the stridor so masks the auscultatory phenomena that it is impossible to distinguish with accuracy the extent of the false membranes, the degree of pulmonary engagement, the coexistence of bronchitis, or the commencement of effusion. Now supposing it complicated with bronchitis, or, as Mr. Porter asserts is frequently the case, the disease commences in the bronchial ramifications, and extends upwards, the issue would be more than doubtful, for though the air be admitted its arterialization must be imperfect. On this point also we must not forget, that bronchitis, slight or severe, is certain to follow the operation, and that children, or those who have suffered from difficult respiration, are very unfavourable subjects for its occurrence. Thus we may be adding a fatal disease in a case which has not gone so far as to preclude all hopes of a favourable termination by the expulsion of the lymph. Again: Dr. Cheyne has urged that the cohesion of the lymph is often so slight, that it would be impossible to lay hold of it so as to remove it; and that in many other severe cases there is no continuous membrane, the secretion from the inflamed surface existing in the form of shreds and detached portions.

In the last stages, when congestion of the brain has taken place, convulsions or coma supervening, and the patient appears to be sinking, though in Mr. Chevalier's cases and in some others it was successful, in the vast majority it would only bring surgery into disgrace.

It is not unreasonable, however, to suppose that there is a period in some cases in which the inflammation has ceased, or has been subdued by the treatment employed, and the effusion of lymph no longer continues. Perhaps the lymph has been too much considered as dangerous by the mechanical obstruction it produces, whereas its worst effects are often those of causing irritation to the muscles acting on the glottis, and exciting them to spasmodic action. If this be correct, it is plain that bronchotomy is indicated in such a case as has just been alluded to, provided the happy moment can be seized, before pulmonary effusion or cerebral congestion supervene.

Bretonneau has recommended the operation in cases of croup from the extension of diphtheritic inflammation of the fauces. He operated in three cases, one of which recovered; but we require further facts on this point before any general rule can be laid down.

The operation might be proper, if it appeared probable that the obstruction was owing, as in Mr. Chevalier's cases, to the accumulation of mucus, and if such proved to be the case, it would probably be followed by the happiest results. On this point we must not mistake the convulsive efforts a patient makes to free himself from the mucus, or from any obstruction in the air passages, for the convulsions arising from cerebral congestion.

Now as to the last stage. Its performance has been generally and justly condemned by all the best authorities, but it becomes a question whether this rule should be strictly adhered to, if such a case occurred, when the friends of the patient were intelligent persons, and should desire the operation, after it had been pointed out to them how little probability there was of a happy result. Under such circumstances, I conceive, neither the surgeon, nor his art, would fall in the estimation of the parties. Some cases *might* recover, as some have after all hope was extinct, and very frequently one of our noblest objects would be attained,—alleviating suffering, and smoothing the pillow of death.

I cannot, however, conclude this section better than by the following table, showing the results which various celebrated French operators have obtained, according to their own declaration in a late discussion at the French Royal Academy of Medicine, after employing bronchotomy in croup.

	Operations.	Cures.	Deaths.
Amussat . . .	6	0	6
Baudelocque.	15	0	15
Blandin . . .	5	0	5
Bretonneau	18	4	14
Gerdy . . .	6	4	2
Roux	4	0	4
Trousseau . .	80	20	60
Velpeau . . .	6	0	6
	140	28	112

3. Œdema of the glottis, or the submucus cellular tissue of the larynx. This disease has many symptoms in common with the phlegmonous laryngitis. There are the same fits of difficult respiration, spasmodic cough, and threatened suffocation. The same difficulty of inspiration, freedom of expiration, pain in the region of the larynx, and alteration of the voice. Indeed, it is often totally impossible to ascertain the exact nature of the various inflammatory diseases of the larynx. But if on passing the finger along the tongue to the upper extremity of the larynx, a soft tumour can be felt about the margin of the aperture of the glottis, the case is pretty clear. This, however, only occurs when the epiglottis and rima are implicated to some extent. If so, the

epiglottis becomes erect, causes difficult deglutition, and as the glottis cannot be perfectly closed, drops of fluid often pass into the larynx, exciting much irritation. It is not unusual to find the laryngeal surface of the epiglottis œdematous, the pharyngeal being unchanged.

Mr. Liston is of opinion, that bronchotomy is more frequently demanded on account of œdema glottidis, than from any other circumstance. He says, diseases of the larynx are very common in Edinburgh, and he must have performed the operation nearly twenty times, with almost uniform success, for chronic swelling, with urgent and threatening symptoms.

In such cases then, or indeed in any, when urgent symptoms are produced by disease confined to the larynx itself, bronchotomy should be early insisted on, medical treatment being very uncertain in its effects, and often injurious. The operation gives immediate relief; it places the organ in the state of rest so necessary for the successful treatment of the disease; it gives time for the operation of remedies likely to be useful; and if performed early success is almost certain; if delayed till the last stages, the observations just made on croup and laryngitis, under the same circumstances, are equally applicable.

There are, however, some forms of this disease, where more time is allowed for deliberation, and to try the effect of medical treatment. I have seen a case, in which the duration of the disease was upwards of three weeks from its commencement to its fatal termination. Here the symptoms should be attentively watched; and if they increase, notwithstanding the measures employed, it will be better to operate, even though the symptoms be not very urgent, for the reasons just stated.

I shall next consider the indications for the operation.

4. In cases where strong acids, caustic, or corrosive substances, or boiling fluids, have been swallowed, or the steam of boiling water inhaled.

This subject naturally follows the last, as death is produced in almost every fatal case, not by the ordinary local effects an injury of the kind is likely to give rise to, but because respiration is obstructed, from the serious injury the glottis has suffered impeding the transit of air. And further, as the pathological changes, independent of the excoriation of the mouth and fauces, are very similar; viz. effusion of serum into the submucous cellular tissue around the glottis, many small vesicles on the surface, with vascularity of the mucous membranes, and a coating of lymph or viscid mucus on it.

The *usual* symptoms are pain, difficulty in deglutition, and all the signs of impeded respiration.

Leeches should be applied, calomel, &c. given; but if the symptoms do not abate, or if they increase in urgency, the operation should be performed without delay; and if the danger of the case arises only from the injury to the larynx, other parts not being seriously injured, the best results may be expected to ensue. If put off long it will be probably useless, for the reasons so frequently stated; but if the friends understand, that while it is the only chance, it is but a chance, it should be undertaken.

Mr. Burgess has related two cases in the Dublin Hospital Reports, in both of which the child appeared lifeless. The operation was performed: one perfectly recovered; the other lived twelve hours, but died evidently in consequence of her attendant neglecting to keep the wound free, by regularly removing the mucus which collected within it. Mr. Porter relates a case which occurred to Mr. Adams, when it was performed with success nine hours after the accident: respiration being fifty in the minute, and performed with difficulty; inspiration attended with a croupy sound, the surface of the body cold, face pale and swollen, eyes sunken and glassy, pulse extremely feeble, and so frequent that it could not be counted.

5. In acute functional affections of the windpipe.

(*a*) *Spasmodic Croup.* In this affection there is neither inflammation, nor the membranous exudation of croup, and the symptoms are produced by spasm, not by any mechanical cause independent of spasm. It differs from ordinary croup, as in the latter there are almost always some premonitory symptoms, cough, hoarseness, &c., whereas in the spasmodic form the attack is always sudden and unexpected. In ordinary croup, though there may be some abatement in the most violent symptoms for a time, yet there are no perfect intermissions. In the spasmodic form the attack soon subsides, as suddenly as it came on, and in the intervals between the paroxysms the patient is perfectly easy, there being merely a slight hoarseness from the previous straining. This form is not confined to children, as the ordinary croup is.

If this affection be properly treated, bronchotomy can very seldom be required. But cases may occur where suffocation is imminent, and then, if performed immediately, it will generally be followed by the most brilliant success. Even if the patient be apparently dead, if very speedily performed, it offers the most certain means of resuscitation.

(*b*.) Dr. Albers, of Bonn, has recommended bronchotomy in a form of spasmodic affection of the larynx, occurring in girls subject to irregular menstruation, and characterized by convulsive cough lasting for two or three hours, till the patient falls into a swoon, or even convulsions. I am not aware of such cases having been observed in this country, and Dr. A. does not appear to speak of its good effects from experience.

(*c*.) Under this head we may also consider the spasm of the glottis, which occurs in infants—the crowing inspiration of children. (Laryngismus Stridulus of Good and Ley).

It is not within my province to enter into the nature, causes, or symptoms, of this affection. The subject has been ably treated by Drs. Corrigan, Ley, and Marsh. When accompanied by cough it might be mistaken for pertussis; but it may be distinguished by the suddenness of the attack, the *complete* suspension of respiration, and the absence of vomiting. It differs from croup in having complete and perfect intermissions, and in the peculiar piercing shriek with which the attack is ushered in.

All that has here to be considered is bronchotomy as a means of relief during the attack. It has been proposed by Dr. Ley, but it should by no means be regarded as a remedy frequently applicable; for if the obstruction to respiration be not absolutely complete, the attack is seldom fatal. Even when asphyxia has appeared complete, in a few seconds animation has returned. But if called to a case where the child is apparently dead, and has been so only for a short time, artificial respiration should be performed by a bellows to the nostril, or through an elastic tube introduced into the larynx. If, however, these are not at hand, or any delay or difficulty should occur in their application, the operation should be immediately performed; and it is satisfactory to know that it has succeeded under such circumstances.

III. In chronic diseases of the windpipe.

Chronic laryngitis, and its effects, viz.—thickening of the mucous membrane—ulceration, simple or specific, earthy degeneration of the cartilages, and the formation of abscess around—mortification of the cartilages, also accompanied by abscess.

This is not the place to treat of the pathology of the larynx; what is required is to state those circumstances in its chronic diseases, requiring the aid of surgery. Now if we have a case, where certain symptoms indicative of laryngeal disease are produced merely by a thickening of the mucous membrane, the result of previous inflammation, or combined with existing inflammation in a chronic form, such a case is one in which bronchotomy, if performed sufficiently early, will be almost certainly successful, and it is probably the case where its success has been more frequent than for any other disease. It will not injure the patient: it is the only means for preserving his life, after mercury and other appropriate treatment has failed. It may be the means of directly saving life in a sudden paroxysmal exacerbation of the symptoms; or indirectly by placing the organ in the state of rest so necessary for the successful treatment of its diseases; a state in which nature, unassisted, may bring about a cure. It will remove the danger of pulmonary congestion, and the liability to organic changes in the lung.

It unfortunately happens, however, that in the present state of our knowledge, it is often absolutely impossible to discover the precise changes the larynx has undergone; the difficulty of respiration, with occasional paroxysms approaching suffocation; metallic cough; muco-purulent expectoration; sense of uneasiness about the larynx; with the effects of the general debilitating influence of disordered respiration: low fever, night sweats, and emaciation, are common to all the chronic diseases of the larynx. There are certainly some symptoms indicating the more profound diseases; generally greater pain on pressing the thyroid cartilage, or rubbing the larynx across the spine; gangrenous fœtor of the breath, not mercurial; greater pain in swallowing; and the case is put beyond doubt, if portions of the degenerated or disorganized cartilages are expectorated. But these signs are not sufficient to enable us to determine accurately either the precise seat, or exact nature of the disease. Nor is such knowledge absolutely necessary to vindicate the propriety of the operation, for in all cases where symptoms such as I have just enumerated continue after the employment of proper treatment, the operation should be performed at once. And even if the other changes have taken place, it should be undertaken, as it is the only hope, and as many cases have been recorded where it has proved successful, though with the necessity for wearing a tube to breathe through. Mr. Porter says, there are at present in Dublin four persons on whom he operated for these affections, artificially respiring, without any prospect of being otherwise able to exist for the remainder of their lives. Trousseau relates a case in which the patient wore a silver canula for twelve years. To say the least, life will be prolonged, and suffering alleviated; and as neither the cartilages of the larynx, nor its mucous membrane, are in themselves necessary to life, if there be no complication of pulmonary disease, a perfect cure may be anticipated, with the exception of the necessity for wearing a tube.

Mr. Carmichael has recorded some cases where he operated with success, on account of ulceration of the mucous membrane, the result of syphilis. The remarks just made as to the indications for the operation will also apply here.

IV. In cases where tumours in the larynx itself, or in the neighbourhood, obstruct the passage of air, either mechanically, or by exciting spasm of the glottis.

1. *Foreign bodies in the fauces, pharynx, or œsophagus.*

(*a*) Such a substance may be in the fauces, on the epiglottis, so as to completely close it, and cause instant death. This accident generally occurs in children, or others, hastily attempting to swallow large, or imperfectly masticated portions of food. Mr. Porter gives two cases in which dissection showed substances lying on the epiglottis, and effectually shutting it down.

The patient makes two or three convulsive attempts to inspire, throws his arms wildly, falls as in a fit of apoplexy, his face livid and swollen, lips blue, eyes wild, and starting as it were from the sockets: no pulse can be felt at the wrist; in fact, he appears to be dead.

The body is beyond the reach of the finger, and a probang would in all probability pass over it towards the back of the pharynx.

The patient must die, if proper treatment be not instantly adopted. Is bronchotomy, then, to be performed? If the surgeon happen to have an elastic tube in his pocket, and he is able to remove the body from its situation, he should, of course, introduce the tube through the nostril into the windpipe, and immediately commence inflating the lungs. It is the duty of every surgeon to acquire dexterity in this manœuvre by frequent practice on the dead subject.

But suppose, what is often the case, the body cannot be stirred; or what is still more likely, the surgeon has not a tube at hand, not a moment must be lost in performing bronchotomy, and commencing artificial respiration. Directly the trachea is opened, the air will force up the epiglottis, and propel the foreign body into the mouth. If not too late, success will be almost certain, for the lungs are perfectly healthy, and the danger has been caused simply by a deprivation of air, from the closure of the glottis.

The patient must be closely watched, for in all persons who have been nearly asphyxiated there is such debility, that relapses are common; and this forms a strong objection against the use of elastic tubes, as much irritation is caused by passing and repassing them; and if left they will excite inflammation.

(*b*) A body may lodge in the pharynx, so as to cause only partial pressure on the epiglottis, and symptoms are produced resembling those of the last case, but of course in a lesser degree; the obstruction being in this partial, in the former complete. In this case, if we find the patient struggling to get rid of the substance, all that is necessary is to remove it, but if the case has gone on till he is in the state just described, when the body is on the epiglottis, bronchotomy must be performed, the lungs inflated, and the other treatment proper in cases of asphyxia vigorously employed. Habicot operated successfully on a boy, who attempted to swallow nine gold pieces wrapped in paper. They lodged in the narrow part of the pharynx, could not be moved, and the boy was in danger of immediate suffocation.

(*c*) It is the opinion of Mr. Porter, that the stoppage of a foreign body in the œsophagus, though it occasions alarming symptoms, they are not such as indicate immediate danger of suffocation, and can never require bronchotomy. He says, " there will be no difficulty of breathing beyond what must be occasioned by absolute pressure on the posterior membranous part of the trachea."—" When spasm is excited, it must be in consequence of some irritation applied to the larynx itself, and not extend to, or at a distance from it." If this be the case, bronchotomy could scarcely be thought of, for any substance small enough to pass the glottis could be forced into the stomach, unless it were of such a nature that the attempt would be likely to injure the œsophagus, or neighbouring parts, in which case œsophagotomy would be the best operation. And if we look merely to the mechanical effect of such a body on the trachea, bronchotomy, to be useful, must be performed below the situation of the body, that is, the trachea must be opened immediately above the sternum. The great danger, then, of the operation in this situation, and the fact that the first cause of the evil is not remedied in the least, are sufficient reasons why bronchotomy would be improper.

But Dr. Stokes considers that spasm of the glottis may be caused by a foreign body lodging in the œsophagus, on the ground of a case recorded by Mr. Kirby in the Dublin Hospital Reports. He also states, that he has seen an instance where a piece of money was lodged in the œsophagus, *not in the fauces or pharynx*, when croupy breathing, and other laryngeal symptoms were the result. He also mentioned a case in his course of lectures at Park-street the session 1838-9 in which such symptoms were produced by a foreign body in the *œsophagus*, that his first impulse was to perform tracheotomy with a penknife. As it afterwards proved, the size of the body was such, that such effects could not have been produced by any mechanical pressure it occasioned; and the spasmodic nature of the attack became still more evident when a perfect intermission of the symptoms took place, and the child fell asleep. Mr. Cusack was sent for; the child awoke; another paroxysm came on; he passed a bougie into the stomach, and all the symptoms then vanished. In a day or two the child passed some foreign body, I believe a fruit kernel, which it was known to have been playing with at the time.

Now if it be allowed that a body in this situation may excite spasm of the glottis, it is possible a case might occur in which bronchotomy was required. For instance, if suffocation were so imminent, that the delay of getting an œsophagus bougie, or, if one was at hand, some difficulty occurring in the removal of the body, rendered any other course dangerous; or, if the surgeon arrive very soon after apparent death.

2. Operating in a similar manner, that is, either by mechanical pressure on the glottis, or by producing spasm of its muscles polypi sometimes produce danger of suffocation, and the operation of bronchotomy is required to preserve the existence of the patient. This case very rarely happens, for it is seldom that a polypus in this situation can neither be extracted, nor its size so lessened (by puncture, or excision of part of it,) as to remove the difficulty of respiration. But that it sometimes occurs, appears from a statement in Mr. Hargrave's work on operative surgery, that he assisted Mr. Gregory in performing tracheotomy at the Coombe Hospital on this account. I have since learned from Mr.

Hargrave, that the polypus occurred in a child, and it was impossible to extract it.

These polypi may be either growths from the mucous membrane of the œsophagus or pharynx, or nasal polypi projecting through the posterior nares into the pharynx.

The same danger may accrue, and the same necessity arise for the operation, from polypi growing in the larynx itself. I am not aware of any means by which such a growth could be accurately distinguished; all I can say is, that Dupuytren operated in two cases on this account; and I should think it likely that an accurate stethoscopic examination would lead to a pretty accurate diagnosis, provided it was made at a time when there was a remission of the stridor, &c. There would also probably be a dulness on fillipping the larynx at the part from which the tumour arose. Besides allaying the urgent symptoms, bronchotomy is the only way to get at the growth to extirpate them. If the case could be made out, the operation is indicated, as the patient is liable at any time to instant death, from the polypus being thrown into the glottis.

3. Fibrous, or other chronic tumours, growing from the structures behind the œsophagus, have occasionally been noticed. Lieutaud relates four cases where deglutition was thus impeded. It is obvious that respiration might also suffer greatly, but I am not aware of any case where bronchotomy has been performed on such grounds. It might be necessary provided it were impossible to remove the tumour, that there was danger of suffocation, and that the situation of the tumour was such that the trachea could be opened below it.

4. Abscesses in the neck sometimes produce those symptoms considered as indicating a necessity for bronchotomy. Those occurring in consequence of disorganization of the laryngeal cartilages have been before spoken of. They also occur about the glottis, giving rise to all the symptoms of croup, in the course of fevers, and in the acute eruptive disorders of children. Death has been caused in a child eight months old, by an abscess bounding the front of the thyroid cartilage, and nearly the whole extent of the os hyoides. Mr. Carmichael has related cases in which abscesses about the throat had occasioned suffocation; in one bronchotomy was performed, though unsuccessfully, the abscess not being recognized. He says, " It is true that abscesses are every day met with in the back of the pharynx obvious to the sight and touch. For these the remedy is apparent, and affords immediate relief. Others are situated so low as not to be visible, and are, in many instances, beyond the reach of the finger. Such cases may be indicated by the precise seat of the pain; the obstruction in the first instance to the passage of aliment, afterwards, as the swelling increases, to the passage of air; the slower progress of the symptoms compared to those of laryngitis, and the more rapid when compared to those of stricture of the œsophagus, or of chronic tumours pressing on that canal;" " the obstruction to the passage of an instrument down the œsophagus, while those complaints about the fauces, which might occasion obstruction, are absent; a general swelling of the anterior part of the neck, almost approaching œdema, analogous to what occurs over any deep-seated abscess; and, probably, rigors."

If the nature of the case be discovered, no necessity should arise for bronchotomy. The abscess of the œsophagus may be opened, by very cautiously introducing a trocar; and Mr. Porter has shown, that even if abscesses of the neck are in situations, where it would be dangerous to open them, an incision being made through the integuments, they will open there of themselves in a short time. It could scarcely happen that an abscess could produce sufficient pressure on the windpipe to cause dangerous symptoms, and that a surgeon, knowing the anatomy of the region, could not open it without wounding any important part. The child's life might evidently have been saved, had the abscess in front of the thyroid cartilage been opened, which, as has just been stated, caused its death.

The signs denoting the existence of a deep-seated abscess in this region, are often obscure; but there is a peculiar kind of fulness, and often an obscure sense of fluctuation, which will be sufficient guide for an experienced surgeon.

5. *Enlargement of the Tongue.*—This sometimes occurs in small-pox, in malignant fevers, from the stings of insects, or the abuse of mercury, and to such an extent as completely to block up the fauces. In such a state of things bronchotomy has been recommended, and was performed by Mr. B. Bell with success in a patient, who was thus almost suffocated. I can scarcely conceive, however, that the operation could be required in these cases, for extensive scarifications of the tongue, or a passage of a tube through the nostril into the trachea, would seem likely to answer every purpose. It might, perhaps, be indicated in a patient who had been apparently dead for a very short time, as one of the speediest means for restoring suspended animation.

6. *Enlargement of the tonsils.*—The acute inflammatory swelling, and any effect it may produce likely to render bronchotomy necessary, may in general be remedied by evacuating the matter, which is the cause of the enlargement. Flajani, however, has given some cases where it was thought necessary from the danger of suffocation. Brasavolus, as we have stated, asserts that he himself opened the trachea, in the case of a patient labouring under quinsy, and on the point of death, and thus saved his life. Garengeot in the Traité des Opérations, speaks of a lad attacked with a violent quinsy, completely relieved by bronchotomy. Many other cases are to be found among the old writers, under the appellation " angina;" but it appears ex-

tremely probable that many of these were nothing more or less than acute laryngitis, or chronic œdema glottidis; and that the cases of Dr. Pitcairn and Mr. Hayes, though the first in which the symptoms were accurately detailed, were by no means the first specimens of the disease.

In the chronic enlargement of the tonsils, the operation can hardly be necessary, for excision should be performed before they are of such a size as to interfere with respiration; and even if such obstruction be produced, the excision of the enlarged mass, or the introduction of one of Desault's tubes, will probably be sufficient.

7. *Enlargement of the thyroid gland* (Bronchocele),—when very great, is apt to cause much obstruction to the respiration. Three operations have been performed for the removal of the disease, or its effects. Excision of the gland, tying the superior thyroid arteries, and bronchotomy. Mr. Gooch gives two cases where excision was practised, and the uncontrollable hæmorrhage which followed is sufficient to prevent imitation. The thyroid arteries have been tied by Sir W. Blizard, Walther, and Landshut, and Mr. Coates of Salisbury, and the results have been such, that in most cases this would be preferable to bronchotomy, as the latter could do nothing towards reducing the enlargement, which was the primary cause of the symptoms. Mr. Sharp, however, in his treatise on surgery, published in 1761, regards the pressure of a large bronchocele as the principal ground on which the operation is called for.

If suffocation, however, be threatened, bronchotomy should be performed. Desault, even in this case, has advised his tubes; but their continuance in the trachea would be so likely to produce dangerous inflammation, that bronchotomy appears far preferable.

8. *Aneurism of the aorta.*

Bayle relates a case where an aneurismal tumour compressed the left bronchus, and gave rise to such symptoms, that he says, had he seen the case himself, he is persuaded he should have mistaken it for œdema of the glottis. Dr. Hope says, that bronchotomy has been several times performed, with the view of obviating suffering caused by aortic aneurism. Mr. Lawrence has related the case of a young woman, under twenty years of age, who died, suffocated from an aneurism behind the sternum, pressing on the trachea. Her symptoms were so deceptive, that it was supposed bronchotomy would be required. And it occurred some time since, in London, that an eminent surgeon was charged with malapraxis, for having operated under such circumstances.

It becomes an important point, then, to learn how we are to discover when symptoms of laryngeal disease are produced by aneurism of the aorta, and to inquire how far bronchotomy is to be recommended in such cases.

The first thing which will strike one who has seen instances of the kind, is a want of that proportion between the intensity of the stridor, and the forced efforts at inspiration which always exist in disease at the top of the tube. The patient may have intense stridor, and be making comparatively slight exertion of the auxiliary respiratory muscles. On the other hand, these muscles may be in a state of the most violent action, especially those of the neck, while the stridor is comparatively very feeble. In disease of the larynx, this want of proportion never occurs. Again, the stridor, in disease of the larynx, is louder at some little distance from the patient, than on listening with the stethoscope applied over the parts; in aneurism of the aorta it is directly the reverse. In aneurism the stridor often seems to come from behind the sternum—" the stridor from below," of Dr. Stokes—its direction is evident, and the patient is himself sensible of it. In the next place, the character of the voice is not altered, or, at least, very seldom; and when it is, it differs greatly from the alteration produced by laryngeal disease, being singularly variable in its tones. The upper part of the sternum, sternal ends of the clavicles, and parts about, should be percussed: if there be dulness it evinces something more than can be accounted for by any disease of the larynx. If this dulness be circumscribed, combined with the other symptoms, it will go very far to establish the diagnosis of an intra-thoracic tumour. This will be still further strengthened, if there be any signs of compression of one bronchus, subclavian artery, or the œsophagus, viz. clearness of sound on percussion, with absence or great diminution of respiratory murmur, diminution of the pulse of the affected side, or dysphagia.

This is sufficient to establish the diagnosis of an intra-thoracic tumour; and from the great frequency of aneurisms compared to other such tumours, we may act as if aneurism were the cause of the symptoms. This will further be strengthened, if there be pulsation, or bruit de soufflet; though it must be remembered, the latter is often absent in aneurism, and the former may arise from the pulsation of an artery being communicated to a cancerous tumour of the lung. The practitioner should also be on his guard against the complication of laryngeal disease by aneurism, though I am not aware of any such case on record.

We may say, then, that if by the signs just enumerated, an intra-thoracic tumour have been discovered, we may act as though it were certainly an aneurism, and that the aneurism is the cause of the symptoms of which the patient is dying. The question is, Would a man be justified in performing bronchotomy under such circumstances?

It was argued at a late meeting of the Dublin Medico-Chirurgical Society, and Dr. Corrigan appeared to agree in the opinion, that aortic aneurisms sometimes produce danger of suffocation, not by the mechanical pressure they exert on the trachea, but by exciting irritation and spasm of the glottis. If this be the case, I think bronchotomy should be performed, as it would certainly prolong the life of the patient. And as we all know that aneurisms of the aorta have undergone a spontaneous cure, it might be the means of indirectly effecting a perfect restoration. It should, however, be invariably impressed on the friends, that the operation is performed on account of a disease which is almost always fatal, and that temporary relief can alone be expected. But as this relief is so great, and as it may be a considerable time before the aneurism bursts, I think it is clearly the duty of the surgeon to operate, *provided spasm be the cause of the symptoms.*

On the other hand; if we suppose the danger to have arisen from mechanical obstruction, this will have first operated on one bronchus, by which the corresponding lung is rendered useless; and if the other lung has become so diseased as to induce danger of suffocation, it is evident that the operation would be useless and unjustifiable. Useless, as death is approaching, not from obstruction to the air, but from disease of the lung, which the operation could not remove. Unjustifiable, because by a careful examination the surgeon might make himself acquainted with the true state of the case. For if spasm exist, both lungs will obviously be in the same state, or nearly so, as regards the transit of air; but, if a bronchus be compressed, we have the physical signs indicating this state; and if the other lung be suffering from congestion or inflammation, we have dulness, and the various râles observed in these cases.

We might have an aneurism compressing the trachea itself, at or just above its bifurcation, but I apprehend, that in this case the obstruction to respiration would have been so long continued before symptoms of suffocation would supervene, that the lungs would have suffered so much as to render the operation useless, even if the passage for the air could be satisfactorily restored, which appears to me very doubtful.

9. Enlarged bronchial glands, or cancerous tumours around the trachea, would produce the same effects on the respiration as an aneurism of the aorta; and if there be great danger of suffocation, this is sufficient warranty for bronchotomy, as it is the only means of saving life. If the danger has arisen from the bronchial glands, it will also give time to try the effect of iodine, and thus may not only be a means of prolonging life, but of effecting a cure.

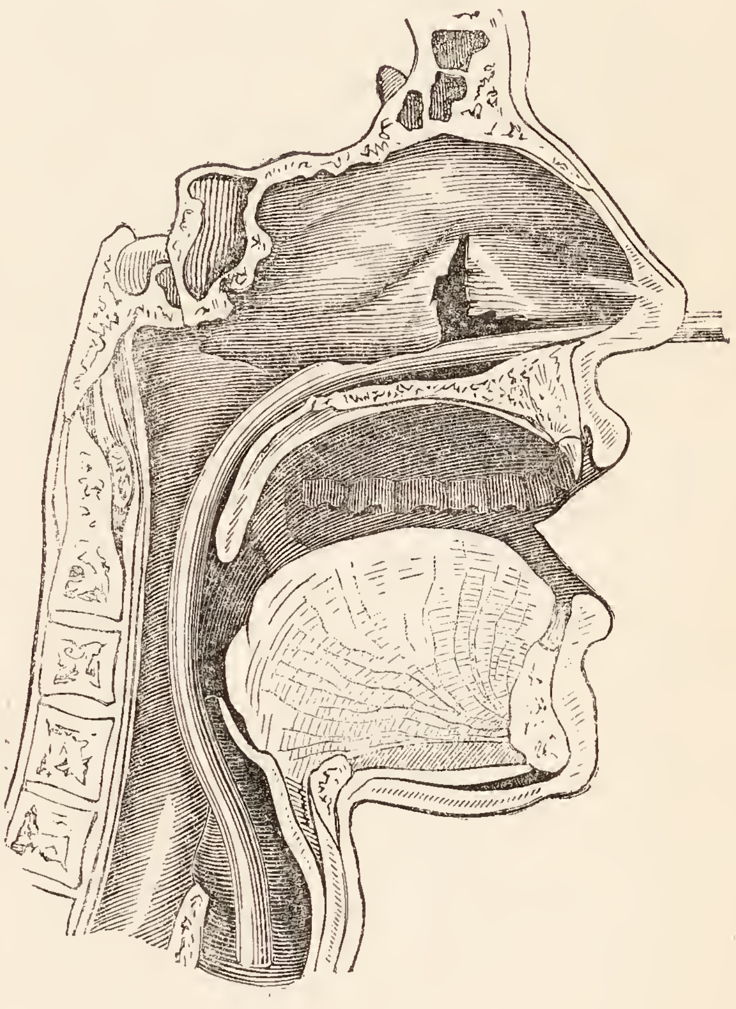
V. *Injuries and wounds of the throat.*

This is not the place to treat of the different wounds of the throat, the sources of their danger, or the treatment applicable to each. We have simply to consider, under what circumstances bronchotomy may be required, in the treatment of such accidents.

It may be necessary to, 1. prevent rapid suffocation, which is liable to ensue from the tumefaction of the parts about the glottis, in consequence of inflammation, or (2) to place the upper part of the air-tube in a state of rest, which is absolutely necessary for its adhesion, if wounded.

(1.) Desault has objected to the operation, on the grounds, that another wound is added, which increases the difficulty of the cure; that new inflammation is excited; the danger of hæmorrhage; and the probability of an aerial fistula being the consequence. He has proposed the introduction of an elastic tube through the nostril into the trachea as a substitute.

Fig. 158



Now, if the surgeon be *au fait* at the introduction of the tube, (an operation which it is the duty of all to practise frequently on the dead subject,) the swelling about the rima be not so great as to prevent it, and no very great irritation be produced, the tube is doubtless to be preferred. But it is very seldom that this fortunate combination of circumstances occurs. As to the danger of new inflammation, or increase of that already existing, the presence of a tube in the larynx seems far more likely to be injurious than a simple incised wound. If there were any certainty of the occurrence of hæmorrhage into the trachea, this is an accident so distressing in its consequences, that it would weigh strongly against the operation. But when speaking of the operation itself, I shall show that it may almost always be avoided. As to the danger of aerial fistula, it is far more imaginary than real. Desault himself does not say he ever saw a case, and when it does occur it is only when large portions of the windpipe have been carried away. Mr. Porter mentions one case, and Dr. Stokes lately exhibited a man at the Meath hospital in this situation, but I am not aware whether it was the same individual or not.

It would appear, then, that generally speaking, the operation of bronchotomy is the best practice in cases where some surgical assistance is required, to relieve dangerous symptoms of obstructed respiration, the consequence of a wound.

2. Sometimes the larynx and œsophagus are both opened by a cutting instrument, and at every attempt to swallow, some portion of food escapes through the wound, as does the mucus which accumulates in the trachea. Thus constant irritation is kept up, convulsive cough is excited, the closure of the external wound and the adhesion of the œsophagus prevented, erysipelatous inflammation set up, and the patient is kept in a constant state of agitation until he dies. Now, if the passage of the food and mucus through the wound can be prevented, and the parts kept perfectly quiet, they might heal by the first intention.

To effect this object, the patient should not be allowed to swallow, until the adhesive process may be supposed to be fully established, (he may be fed by an œsophagus tube,) and if bronchitis supervene, bronchotomy must be performed, to afford a free exit for the mucus, without irritating or disturbing the wound.

It must be remembered, that a foreign body may enter the trachea, and give rise to a necessity for bronchotomy, the situation where it entered being almost indiscoverable. Portions of clothing may be forced in by a gunshot wound, the trajet of the ball being such as not to lead to a suspicion of the accident. La Martiniere gives a very remarkable case of a child, who had all the symptoms of greatly impeded respiration, with pain in the trachea. The case appeared a very doubtful one; but a small red spot was perceived just below the cricoid cartilage, and under this a small hard body was felt. It was cut down on, and a pin extracted. It appeared that the child had been playing with a whip, which had a pin at the end of the thong, and in smacking the whip the accident had occurred.

3. A blow or contusion on the front of the neck may cause impediments to respiration. The membrane connecting the rings of the trachea may be ruptured, or the ossified laryngeal cartilages fractured, giving rise to emphysema. In such a case pretty free punctures should be made to prevent the further insufflation of the cellular tissue, and consequent unpleasant results. Inflammation may be set up by a blow, and bronchotomy may be required on account of its effects. Mr. Liston operated with success in a case of this kind. A girl, aged eight years, had fallen and struck the larynx against a stone. Such symptoms were produced, that three hours after the accident death seemed rapidly approaching. Tracheotomy was then performed, and with complete success. The symptoms in this case appeared to arise, not only from the injury to the larynx, probably occasioning loss of power in its muscles, but from the collection of some fluid in the trachea and its ramifications.

4. Suffocation has been produced by retraction of the tongue, after division of the geniohyoid muscles, either by wound, or after the operation of removing part of the lower jaw. Bronchotomy might be necessary, if there was no tube at hand by means of which the lungs could be inflated.

5. From the effects of injury, and sometimes from other causes, as the extension of erysipelas from the face, diffuse inflammation attacks the cellular tissue of the neck, and might so seriously impede respiration, as to render bronchotomy advisable, provided relief were not afforded by free incisions. An erysipelatous or diffuse form of laryngitis has been also described, in which Mr. Porter thinks an operation would be valueless, and death inevitable.

VI. *In cases of suspended animation.*

Whether this be produced by drowning, hanging, or strangling, spasm of the glottis, breathing an impure air, or any of the causes before enumerated, the deprivation of oxygen is the cause of death. Hence the necessity for the artificial introduction of air, in all cases where animation has been recently suspended.

Desault, Pelletan, Mr. A. Burns, Mr. Liston, &c., regard an opening into the windpipe as totally unnecessary to effect this purpose, on the ground, that as the patient is insensible, the curved pipe of a pair of bellows, or an elastic tube can be readily enough introduced into the glottis, either passed through the nostril, or, the tongue being drawn forward, the instrument may be guided along the finger into the glottis.

I have before alluded to the indications for bronchotomy, in the treatment of asphyxia in several accidents and diseases, it only remains then to consider them in cases of drowning—hanging, or strangulation—immersion in carbonic acid gas—breathing other noxious gases—and in the asphyxia of new-born children.

1. In cases of drowning.

This is the case which at first sight appears to weigh in favour of the supporters of Desault and his tubes; for the epiglottis is not closed, and would offer no opposition to their introduction. It must be remembered, however, that in almost all cases where *perfect* suspension of respiration has occurred, actual death follows in five minutes, or less: that these accidents most frequently occur at some distance from the necessary assistance: that if the surgeon have not the necessary instruments at hand, it would be madness to delay bronchotomy, which could be performed with a penknife, till they arrive; that even if the surgeon be on the spot, and have a tube in his pocket, some little delay would arise in passing it into the glottis, and even then it seems very probable he could not sufficiently distend the lungs without a pair of bellows. It would be absurd to have a patient carried to any institution where necessary apparatus is kept, unless it were on the immediate spot.

Supposing the most fortunate combination of circumstances to occur, however, and the surgeon knew himself to be dextrous in passing the tube, he should do so. But if he finds that, for want of bellows or from any other cause, he cannot perform insufflation in a satisfactory manner, he should instantly open the trachea.

On the ground then of the imminent danger of delay, and the rapidity and safety with which bronchotomy may be performed, it will be in the great majority of cases, perhaps, by far the best plan of treatment, as it affords the surgeon the means of immediately inflating the lungs on the spot with his own breath. Mr. Porter says he has frequently proved that this is sufficiently pure, and perhaps the warmth with which it is impregnated may in some respects prove beneficial. As the inflation may have to be continued for some time, some person should be dispatched for a pair of bellows, which may be introduced into the opening so soon as they arrive, or the surgeon be wearied, and the other means found useful in cases of suspended animation assiduously employed.

Leroy's instrument as described in the article Asphyxia would greatly facilitate the passage of the elastic tube, and the bellows sketched in the same article are well adapted to prevent the ill effects which must necessarily arise from too forcible insufflation. They are ingenious and useful, and should of course be employed, if at hand, and in order; but it must not be forgotten that in the great majority of cases the surgeon will be at a distance from any such apparatus, and will be constrained to trust to the most homely utensils. See Asphyxia.

2. From hanging, or strangulation.

The same remarks will apply to these cases as to those of drowning. Bronchotomy is equally indicated, but is not so likely to prove successful, as there is very often sufficient congestion of the brain to cause death. Mr. Porter relates two cases where the persons were taken down while still breathing, but they died; and dissection showed only a vascular and congested condition of the brain.

3. From breathing an impure air.

This case will be very similar to the last, except that here the danger is produced more slowly, and arises from the presence of the noxious gas in the air cells. On this account a pair of bellows should be introduced, so soon as the windpipe is opened, as it is probable the breath of the operator would not be sufficiently pure. I do not see that this last proposition becomes any valid objection to bronchotomy, for a pair of bellows could in almost every instance be readily procured, and if there was any delay in getting them, the surgeon might inflate the lungs with his own breath till they arrived.

4. By immersion in carbonic acid gas.

As spasm of the glottis produces the danger in these cases, the lungs not being necessarily affected, this would seem the case of all others for bronchotomy. It is certainly not a case for the tubes, for the spasm of the glottis has been shown to continue for twenty minutes after apparent death. This would render the bellows to the nostril useless, and cause so much delay, and some danger, in the force necessary to pass a tube, that bronchotomy is very far preferable, and should be immediately performed. But it has not been followed by such success as might be expected *à priori*. Mr. Porter says, " even in experimenting on animals, I have never seen an instance of recovery after immersion in pure carbonic acid gas." Perhaps cold affusion should be combined with it, for it is remarkable, that dogs asphyxiated in the Grotto del cane at Naples, are restored by throwing them into a neighbouring pond.

5. In the asphyxia of new born children.

Bronchotomy is inapplicable, and uncalled for. Even if the surgeon have not a trachea tube, or a catheter, the lungs can be inflated by the child's mouth, its nostrils being closed.

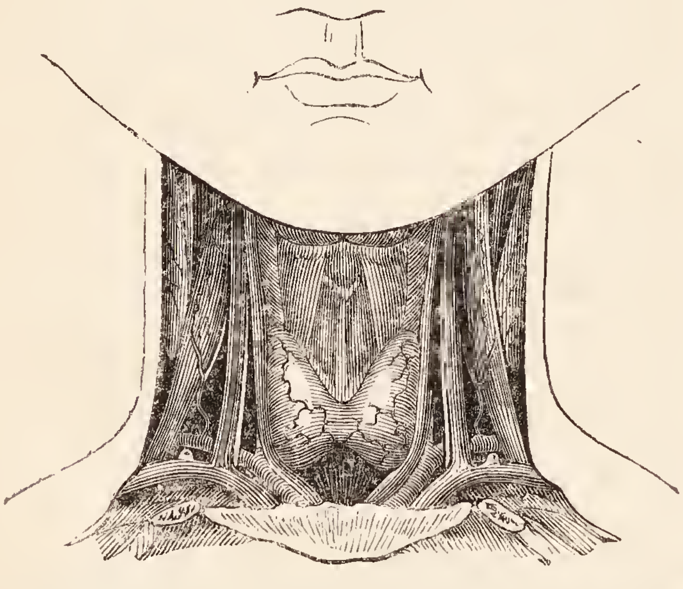
Having thus considered the circumstances under which bronchotomy may be required, I now proceed to treat on the mode of performing the operation.

Provided the operation be properly performed, and the anatomy of the part normal, nothing of importance is likely to be injured. The carotid arteries, jugular veins, pneumogastric, descendens noni, recurrent, laryngeal, and sympathetic nerves, all lie on either side of the trachea. The large portions of the thyroid gland (lateral lobes) are also placed on the *side* of the trachea and larynx; and though the connecting slip (middle lobe) from its close connection to the second, third, and fourth rings, and its situation on the *front* of the trachea, is almost always divided, yet its vessels are so small that they seldom pour out a drachm of blood.

From the importance of the parts, then, on either side of the trachea, we learn that the incision should be most carefully commenced and continued exactly in the median line: for a very slight departure from this course might wound one of the lateral lobes of the thyroid gland, which would certainly be followed by profuse hæmorrhage. That the danger to the vessels and nerves is not merely imaginary, is proved by Desault's statement, that he knew a case where the carotid artery was wounded. From the situation of the subclavian vein also, just behind the upper part of the manubrium of the sternum, it is evident that the incision should not extend to within about half an inch of that bone. And this also appears from the fact, that a large branch of the external jugular vein passes down on each side, and joins its fellow just above the top of the sternum.

The distribution of the vessels, and the situation of the thyroid gland, however, are not always regular. The arteria innominata is in the way of injury in some subjects. Mr. Burns has seen it mounting so high on the fore part of the trachea, as as to reach the lower border of the thyroid gland. He has also seen the right carotid artery crossing the trachea in an oblique direction. Scarpa has seen one instance, and Burns five, where both carotids originated from the arteria innominata, and the left crossed the trachea pretty high in the neck. In one case the innominata gave off a branch which ascended in front of the trachea, and divided into many twigs. Dr. Barclay has a preparation where the two inferior thyroid arteries arose from the right subclavian, one of the branches lying nearly in the line of the small vein which usually covers the trachea, and is generally divided in bronchotomy. Burns saw one case where the thyroid branch of the superior thyroid artery was much larger than a crow quill, and took such a course that it could not have escaped in laryngotomy. The thyroid veins occasionally unite and form a large vessel a little below the cricoid cartilage, which passes down beneath the fascia exactly in front of the trachea. A large vein is sometimes found between the junction of the sterno-hyoidei muscles, and just beneath the fascia, which could hardly escape in laryngotomy. In some persons the lateral lobes of the thyroid gland lie much more in front of the trachea than in others, and Burns saw one case where the connecting slip (middle lobe) was so broad, that it descended almost to the sternum. It is also sometimes so thick, that if divided it would give rise to considerable hæmorrhage.

Fig. 159.

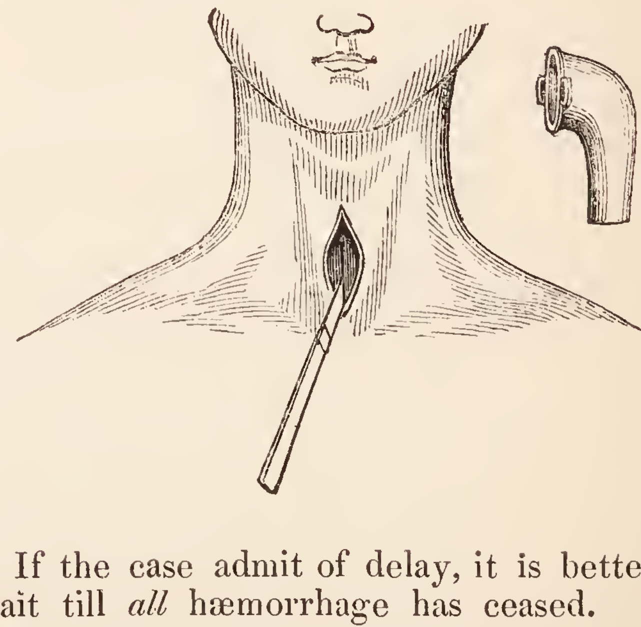


The distance of the trachea from the surface also varies greatly in different subjects. It is generally deep in children, owing to the amount of fat in the vicinity, and in corpulent adults from the same cause. In three cases recorded by Mr. Lizars, the muscles were infiltrated with pus, of course giving rise to a similar condition of parts. The emphysema, which is a frequent consequence of foreign bodies in the trachea, may make it two inches deep. In one of Mr. M'Namara's cases, it was two inches and a half below the surface. Mr. Porter mentions an instance where a *surgeon!* actually could not find the trachea.

These varieties form no objection to the operation, but they should make the surgeon very careful with his knife, as there is no means of knowing the exact arrangement of the vessels, &c. before the integuments are divided.

The surgeon then having determined to perform tracheotomy, and every preparation being made for the safety and comfort of the patient the circumstances of the case will permit, he should be laid on a bed or sofa, or seated in a chair—in either case his head being thrown back to make the part tense. He should be so situated that the light may be thrown on the parts, the operator standing at the head of the patient. An incision should then be commenced, with a small scalpel, a little above the top of the sternum, and carried upwards to a level with the cricoid cartilage, dividing the integuments and superficial fascia exactly in the median line. The divided integuments are then to be drawn aside with bent probes; and it must be carefully seen that this is done equally on both sides, that the bottom of the wound may still correspond with the median line. An accurate examination should then be made for any stray vessel; if such exist it must be depressed, and any fatty matter divided. The knife should now be dispensed with as much as possible, but the deep fascia must be divided over the sterno-hyoid muscles, and their attachments separated with its handle or point. Another examination should be made, any arteries or veins should be pushed downwards, and if the middle lobe of the thyroid gland be large, it must be pushed upwards. A fascia is then seen lying on front of the trachea, part of which must be seized with the forceps, and removed with the knife: for as the trachea moves behind this fascia, it is plain that if the trachea be opened at the same stroke with the fascia, the aperture in the one will not correspond to that in the other. Hence an obstruction to the air would still remain, and the introduction of a canula be also impeded.

Fig. 160.



If the case admit of delay, it is better to wait till *all* hæmorrhage has ceased. The patient is then desired to swallow his saliva. By this action the larynx is drawn upwards, and the tube elongated, and at that moment the knife should be passed into the trachea, with its back to the sternum, and three or four of the rings divided by carrying the knife upwards in the median line. This may be all that is so far necessary; but if it be wished to remove a portion of the tube, a small opening only should be made, to admit a hook or forceps to seize the part, which may then be cut out. Great alarm, anxiety, and distressing sensation follow immediately on the unnatural passage of air into the trachea, but it soon subsides, and the operation may then be readily completed, according to the different cases for which it has been performed.

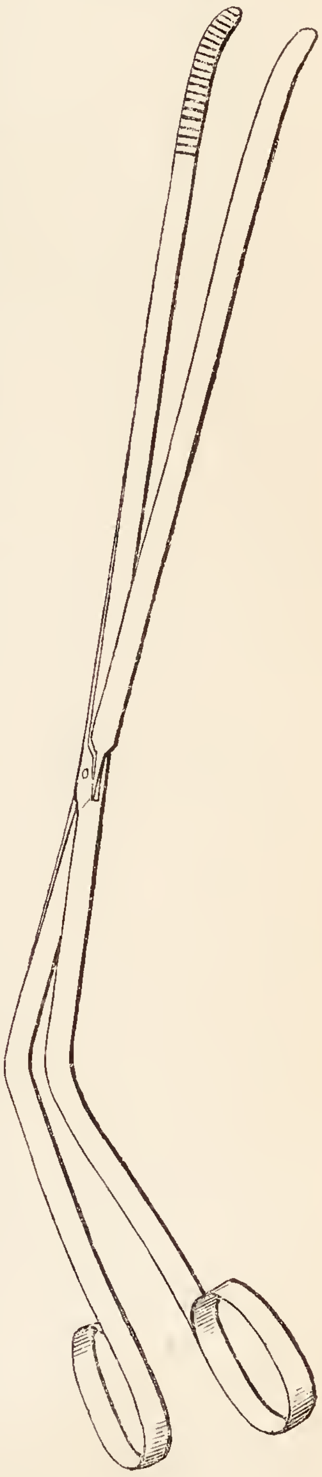
The occurrence of hæmorrhage is the principal danger to be apprehended during the operation, but this will almost always be prevented by proceeding in the cautious manner directed. If, however, it should occur from the division of any considerable vein, the vessel should be tied. If it be an oozing, the nitrate of silver, strong solution of alum, or tinct. ferri murias P. L. may be applied. If the bleeding occur in a very urgent case, the patient's chin should be pressed upwards, but the body bent a little downwards and forwards, so as to obviate as much as possible the drawing or sinking of blood into the trachea, while a small portion of the tube is removed, and a canula of corresponding size instantly inserted, or a trocar might be introduced, but with great caution: probably the ingenious jointed instrument recommended by Mr. Wood, would be very applicable under these circumstances. Richter, and Mr. B. Bell have both described instruments to answer the same purpose. They consist of a lancet blade adapted to a canula: the trachea is to be opened with the lancet, the instrument introduced, the lancet withdrawn, and the canula fixed. Such effects are sometimes produced by the entrance of blood into the trachea, that immediate suffocation appears inevitable. In such a case Roux sucked out the blood, and restored the patient. His example should be followed; and as Louis remarks, in commenting on a somewhat similar case in Van Swieten's commentaries, the patient's head should be turned downward, so as to keep the blood from flowing backward into the trachea. Vigili adopted this suggestion, and with complete success.

If the operation be performed for the removal of a foreign body, the surgeon should be well provided with forceps, variously bent, and of different lengths; some to open laterally, others vertically, and their points formed differently to adapt them to substances of various forms. He should also have one or two long probes.

Mr. Liston thinks a long slit in the trachea quite sufficient to answer every purpose: but Mr. Porter considers that, provided the forceps require to be used, a large portion should be removed from the front of the tube, in order to allow the hinge of the forceps to play with freedom.

The annexed sketch is from a pair of forceps with which Mr. Key removed a sixpence from the bronchus of a boy. He had them made for the express purpose, and assures me that they answered extremely well.

Fig. 161.



As occurred in some of Pelletan's cases, the foreign body is often expelled by a gush of air, the instant the trachea is opened, and this has been strikingly exemplified in Mr. Porter's experiments on a dog. A foreign body was introduced again and again, and as instantly expelled through the wound. If this fortunate circumstance do not occur, the probe should be introduced, to discover the exact situation of the offending substance. It may be loose in the trachea, but its exit prevented by its size or position; if so, it may be laid hold of with the forceps, or removed with a scoop, or bent probe. If fixed in the larynx, impacted in its ventricles, or entangled in the rima glottidis, the forceps must be carefully introduced, and the body gently and cautiously extracted. More difficulty must be expected if it be lodged in one of the bronchi. The distance should be estimated with a probe, forceps selected accordingly, the body seized and removed with the least possible force. After this the edges of the wound may be approximated, and a few days is generally sufficient to effect their adhesion.

If the operation be performed in a case of croup, it must not be forgotten that the false membrane is often in a tubular form, lax, and easily separable from the mucous membrane, so that its collapse from the atmospheric pressure might produce dangerous consequences. This being known, it may of course be guarded against by an ordinary exercise of caution. In these cases some discussion has arisen with regard to the propriety of removing a portion of the trachea, and on the eligibility of the canula. Mr. Liston strongly objects to the removal of a portion of the tube. He says it is a difficult matter, does not answer the purpose long, and is apt to be followed after the healing of the wound by an inconvenient and dangerous narrowing of the trachea. He advocates the use of a large curved canula.

As to the danger of narrowing, I have not read of any cases supporting this view. On the other hand, I have of many, where a portion was removed, and the aperture is said to have been filled with a ligamentous substance, and no narrowing occurred.

Mr. Lawrence strongly recommends the removal of a thin slip of the tube, when the canula causes inconvenience, so as to leave an opening for respiration equal to the natural one. It may be added also, that the canula can neither be introduced, nor retained, so easily if the trachea be simply incised. If this instrument be not used, then the sides of the wound must be held apart by some mechanical contrivance, which is obviously highly objectionable; not only from the danger of its unexpectedly giving way, but from the inflammation it is calculated to excite.

Again, whether should we expect greater mischief, from the continuance of a canula in the wound, or from the removal of a portion of the trachea? Mr. Porter urges many objections to the canula, and I think most men must agree with him. It is highly useful while hæmorrhage continues, but so soon as this has ceased, and the soft parts are sufficiently retracted, it should be removed; as it is liable to cause violent irritation of the mucous membrane, spasmodic cough, and to greatly increase the extent and danger of existing inflammation. It does not allow a free exit to mucus, and as Mr. Porter observes, "the irritation which the instrument causes is aggravated by withdrawing and replacing it when obstructed by a concretion of mucus. Besides, the extraneous body must be irritating the internal membrane, and increase that secretion from an accumulation of which the principal danger is to be apprehended. The membrane of the windpipe above the wound becomes gradually thickened by the irritation of the canula. This alteration of structure may either obliterate the cavity of the larynx, destroy speech, and render the abandonment of the instrument impracticable, or so far diminish its capacity as to augment the difficulty of speaking, and the danger of closing the wound."

Perhaps in some cases where an artificial opening may be only necessary for a very short time, the use of the canula might be better practice than cutting out a piece of the tube. If it be used, it should be carefully secured by tapes passed through its rings, and round the patient's neck: and a piece of light muslin thrown over its orifice to prevent the ingress of any injurious matter. It should also be carefully kept patent, as in one of Mr. Burgess's cases death apparently resulted from a neglect of this precaution. To effect this, a second canula might be introduced within the first, the second being taken out, cleaned, and replaced as often as necessary.

If bronchotomy be performed for the restoration of suspended animation, a large opening must be made in the trachea, to admit the introduction of the nozzle of a pair of bellows.

Dr. Murray has proposed a mode of performing this operation, which certainly appears to offer many advantages. He directs the patient's head to be bent forwards, so as to relax the skin on the forepart of the neck, a portion of which is to be seized between the finger and thumb, and removed at one sweep of the knife. When the head is now turned back, a clear space is exposed on the front of the trachea, into the middle of which a hook or tenaculum is to be introduced between two of the rings. The centre of the trachea is then pulled forwards, and a small piece sliced out. A free aperture is thus left for blowing in air, or sucking out fluid, and as the integuments are retracted to some distance from the orifice, if they bleed, the blood does not enter. Dr. Murray considers that the trachea can be thus cleared to the required extent at one stroke of the knife; that the pulsation of any stray artery can be felt and avoided; that the small thyroid vessels are so put upon the stretch, that after the piece is removed, they retract so as to cause no alarm or annoyance by bleeding; that the trachea is so fixed, that no start, spasm, coughing, or unsteadiness of the patient, can risk the knife touching the important parts in the neighbourhood, or wounding the back part of the trachea; that the integuments cannot be drawn over the new orifice by any convulsive motions or spasm, as Vigili saw in one case; that they are not in the way, either in introducing the pipe of a bellows or a canula; that they easily permit the sucking out of secretions, &c.; and that the operation can be finished so instantly, that the most immediate chance for life is afforded.

I am not aware how far these opinions have been borne out by the experience of practical men, but they certainly appear very plausible, and perhaps there are many cases where this mode of operating might be pursued with advantage.

It now only remains to consider the different situations which have been recommended for the incision into the air tube; and the cases to which each may be applicable.

It has been proposed to make the opening in the hyo-thyroid membrane, the thyroid cartilage, the crico-thyroid membrane, and the trachea.

The first has been recommended by Malgaigne, on the ground that a clear view is thus obtained of the contents of the larynx, and the extraction of foreign bodies facilitated. How far it has answered his expectations when put to the test of practice I am unable to say, but the subject appears to deserve some consideration, especially in cases where any substance was impacted or entangled in the rima; or it is wished to remove polypi growing from the mucous membrane of the larynx.

The frequent ossification of the thyroid cartilage, the danger of wounding the chordæ vocales, and the danger of increasing or producing laryngitis, are sufficient to condemn the section of this cartilage, though Velpeau speaks in its favour.

Laryngotomy offers some advantages in urgent cases from its greater simplicity, and the smaller chance of meeting with any wandering vessel. Also in cases of foreign bodies lodged in the larynx, for the same reasons, as also its greater proximity to the body. This latter argument will of course be against it in cases of inflammation about the upper part of the tube.

It is scarcely necessary to describe the operation. The integuments are to be divided in the median line, over the cricoid and lower half of the thyroid cartilages, the sterno-hyoid, sterno-thyroid, and crico-thyroid muscles separated, and a crucial incision made in the crico-thyroid membrane, or it may be punctured with a trocar. The same objections to the canula will apply with still greater force to this operation than to tracheotomy.

Notwithstanding the greater depth of the trachea in children, its smaller size, the greater risk of hæmorrhage, and their troublesome struggles, tracheotomy appears to be preferable to laryngotomy before the age of puberty; for there is then a greater relative space between the lower border of the thyroid gland, and the top of the sternum, than in adults. This is owing to the greater relative height of the cricoid cartilage, which regulates the position of the thyroid gland. In the adult the larynx is evolved, the cricoid cartilage depressed, and the gland with it, so that the distance between the gland and the top of the sternum is diminished, that above the cricoid cartilage is increased. Thus from the conformation of the parts, cæteris paribus, laryngotomy is more suited for the adult, tracheotomy for the young subject. The neck of the adult female also approaches that of the young subject, the larynx being smaller, and higher in the neck than in the male.

No more cases have been here introduced than I thought absolutely necessary to illustrate the various sections of this article. I have, however, made a collection of most of those on record, and the positions I have taken, are to be regarded as the result of inferences deduced from such cases, the treatment adopted, and its results. Had I narrated many of them, it would have extended the article to an unwarrantable length, and probably proved tiresome to most readers. I am deeply indebted to many of the authors I have cited, and I feel it a duty especially to mention Mr. Porter's work on the surgical pathology of the larynx and trachea, and the invaluable treatise of Dr. Stokes on the diseases of the chest.

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(*Thomas Spencer Wells.*)

BUBO, (*Der.* *βουβών*; *Bubon*, Fr.; *Leistenbeule*, Ger. the groin). A term generally applied to an enlargement of one or more of the lymphatic glands in the inguinal region. Sometimes it has been used in a wider sense, and has been extended to enlargements of lymphatic glands elsewhere. I propose to restrict it, in the present instance, to its popular and limited signification.

Buboes have been commonly divided into *specific* and *sympathetic*.

The specific bubo has been admitted to occur in plague and syphilis, and sometimes, perhaps, in gonorrhœa. It may occur, too, as a consequence of malignant disease in the scrotum, or the penis. I have lately seen an instance of malignant ulceration in each groin, commencing in the inguinal glands, and following similar malignant disease of the prepuce. The sympathetic bubo has been looked upon as the ordinary form in gonorrhœa, an occasional one in syphilis, and a casual result of such general disturbance, or local irritation, as might act on the lymphatics which pass to the inguinal glands, or directly on those glands themselves.

It does not fall within the scope of the present article, to embrace the consideration of specific bubo, whether it originates in plague, in syphilis, in malignant diseases, or in gonorrhœa. The examination of that form, if such there be, will naturally occur in connection with those particular diseases. And I must defer, for a similar reason, to the same opportunity, the investigation of those characters, if any such exist, which distinguish the specific bubo from the sympathetic.

The following observations will, therefore, be understood to apply to enlargement of any of the inguinal glands, occasioned by such general causes as affect the lymphatic system, or resulting from local irritation, including that of gonorrhœa.

The lymphatic glands of the groin are disposed in two planes, the one superficial to the fascia lata, the other immediately beneath it. The former are termed the "superficial inguinal glands," the latter are known as the "deep."

The *superficial glands* are immersed in the mass of subcutaneous cellular tissue and adeps, which is called, and not always with strict propriety, the superficial fascia. They are disposed below the ligament of Poupart, and around the saphena vein, where it is about to traverse the crural ring, and join the femoral. They vary in number and development, in different individuals; and hence, perhaps, one reason for the greater tendency to bubo on the part of some persons than of others.

The *superficial inguinal glands* receive the lymphatic vessels of the dorsum, and inner side of the foot, of the front, inner side, and back of the leg, and the lymphatics of the surface of the thigh; these usually enter the inferior and the central glands. The more internal of the superficial glands receive the lymphatics of the scrotum, of the prepuce, and glans penis in the male, of the labia, nymphæ, and clitoris in the female, and of the perineum in both sexes[1]. The glands in the middle, and on the outer side of the plexus, are supplied by the superficial lymphatics of the hypogastric and the lumbar regions. The more external glands receive the lymphatics of the nates.

The *deep inguinal glands* present more varieties in number and development than the superficial; indeed, they are frequently absent. They are placed, when they exist, below the fascia lata, and beneath the saphenous opening of the crural canal. The deep lymphatics of the foot, the leg, the ham, the anterior, internal, and external parts of the thigh, join the deeper inguinal glands, or, in case of their deficiency, the superficial ones.

I make no apology for introducing these details, because they scarcely enter into a common-place acquaintance with anatomy, and are necessary to explain the liability of particular glands to sympathise with particular parts. We may expect, for instance, that if the surface of the foot, or leg, or thigh, is irritated, the lowermost of the superficial inguinal glands will be affected. And this we often observe in cases of suppuration beneath a corn or bunion, in disease of the toe-nail, or its matrix, in wounds, in erysipelas, or diffuse inflammation of the subcutaneous cellular tissue, after blisters, and from ulcers of various sorts. Indeed, if a patient complains of bubo, and he finds that the glands in question are enlarged, the surgeon may presume that the cause is in the lower portion of the limb, and not in the parts of generation. The suspicion will, in general, prove correct.

I have already remarked, that the glands in connection with the external genital organs of both sexes, are the more internal of the superficial set. They may enlarge from gonorrhæa, more particularly of the inflammatory kind; from acute phymosis; from excoriations or from ulcers of the inner or outer prepuce; from warts; from condylomata on the scrotum or the perineum; from encysted abscess in the female labium; from hæmorrhoids[1]; from fissures of the anus; from abscess in the ischio-rectal fossa, and from fistula; in short, from almost any description of temporary or permanent irritation in these quarters.

As the external glands receive the lymphatics of the nates, we cannot be surprised at boils in that direction giving rise at times to enlargement of them. I have also seen this from a caustic issue in the loins.

In persons who have been subject to femoral hernia, some enlargement of the inguinal glands is not uncommon. The fact is worth mentioning, as inattention to it has led to embarrassment in the operation. M. Ricord, however, remarks, that bubo seldom occurs under a truss, and adduces this as an argument for the employment of compression.

The inguinal glands enlarge at times, independently of any appreciable irritation in the course of the lymphatics leading to them. In some instances, this would seem to depend on an injury inflicted on them. A person, for example, makes some violent exertion, or takes a long walk, and a bubo follows. Or he has connection, and without the occurrence of excoriation, or of gonorrhæa, or of any kind of sore, there comes a bubo. No doubt, the greater number of what the French call the *bubons d'emblée*, and of what has been described as "primary syphilitic bubo," are no more than simple inflammatory enlargement of a lymphatic gland, occasioned by the mere exertion and excitement of coition. I have a patient under my care at present, who was attacked, after sexual intercourse, with a bubo in the left groin. He was going abroad at the time, and put himself under the care of a German physician. The latter assured him that the bubo was venereal, but treated it only by confinement to the couch, low diet, and antiphlogistic remedies. I saw the gentleman at the expiration of some months. A cluster of the inguinal glands was enlarged; some were suppurating, others had suppurated, and the abscesses had either healed, or ended in sinuses; the integument was bluish; and the cellular membrane thickened. There was no trace of a venereal symptom, nor any evidence that venereal contamination had occurred. I sent the patient into the country, but he is not yet well. The glands appear to have suffered too deeply in structure, to be speedily restored to their natural state. Can we doubt that such a case as this (and it is not uncommon) is one of inflammation in a lymphatic gland, occurring in a habit naturally weak, or, by injudicious management, weakened?

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[1] It is not an uncommon circumstance, to find one or more lymphatic glands on the pubes, into which the lymphatics of the prepuce on the dorsum penis enter. The vasa efferentia of these pubic glands, pass, I believe, to the innermost of the inguinal. In inflammatory phymosis, and in acute gonorrhœa, the pubic glands are not unfrequently inflamed; more frequently, if I may trust my own experience, than the inguinal. An indurated absorbent may always be traced to them along the dorsum penis. It occasionally happens, as M. Cruveilhier has remarked, and as practical surgeons must have noticed, that the lymphatics of the penis and the scrotum avoid the glands which are most contiguous, and proceed to the lower ones in the neighbourhood of the saphena vein. A circumstance worth remembering, as it impugns the truth of the current belief, that irritations of the external organs of generation affect only the higher and more internal of the glands of the groin. The rule has its exceptions.

[1] I have twice, after tying internal piles, seen smart inflammation of the inguinal glands. In one case, the glands alone were affected; in the other, that of a lady of a highly nervous temperament, the sub-peritoneal cellular tissue appeared to be extensively inflamed, and the irritation seemed to travel by *that* route to the glands in the crural canal.

Constitutional states exercise an important influence on the production and the course of bubo. There are two conditions of the system, the scrofulous and the cachectic, which are more particularly prone to it. It is in these states, and especially the former, that the inguinal glands are apt to enlarge, without local irritation in the course of their inferent vessels.

For practical purposes it might not be amiss to look at bubo under three points of view: as it occurs in a person of a good constitution; or, in one of a scrofulous habit; or, in one of a cachectic. It may fairly be admitted that it is not always easy to distinguish the two latter constitutional conditions, or their local effects, cachexia being little else than a low state of the bodily powers, to which the scrofulous diathesis may materially contribute. Yet, making every reasonable allowance for this, the difficulty that it gives rise to is rather critical and speculative than real, and occasions no embarrassment in actual practice. I shall, therefore, take the liberty of acting on this division, however faulty it may be, and of sketching, in as brief a manner as possible, the form that is assumed by bubo, and the course it runs, under these several circumstances.

Bubo in a healthy habit.—As a consequence of any of the numerous local causes I have already alluded to, there appears a swelling in one or more of the inguinal glands. It generally begins in one, and is often confined to it; occasionally it extends to several. The swelling feels, to the finger of the surgeon, single or multiple, as one or several glands are implicated, moveable or not, as it is above or below the fascia, is tender when pressed, and more or less painful on, or after, exercise, or even without it. The skin, at first, is not discoloured, unless an inflamed absorbent leads directly to the bubo, when the redness in its track may invade the integument over the bubo itself.

Such a bubo may end in *resolution*, or in *induration*, or in *suppuration*. Under proper management, the former termination is the most common, and the latter is the least so. *Sloughing* of the integument, or of the gland, or of both, is a still more rare termination.

Resolution. Without refining so far as to divide this into "delitescence" and resolution, I may simply observe, that tenderness and pain subside with more or less rapidity, and the swelling gradually disappears. In most instances, however, an inguinal gland, when once enlarged to any size, regains with difficulty its exact natural dimensions.

Induration.—This is a not unfrequent occurrence. The tenderness passes away, the swelling diminishes a little, it then becomes stationary, and so may remain for an uncertain period, for weeks or even for months. In the majority of instances it yields at last—perhaps to medicine, perhaps to time. But, in other cases, fresh inflammation comes upon the gland, it may be with, it may be without any obvious reason, and either resolution or suppuration ensues. This liability to fresh inflammation and to suppuration makes induration of an injured gland any thing but desirable.

Suppuration.—If the inflammation runs high, or, as is not uncommonly the case, the patient does not restrain himself in exercise or diet, the tenderness continues or augments, the swelling enlarges, partly from increase of the gland itself, principally from implication of the neighbouring cellular tissue,—a blush of redness appears upon the skin,—the latter becomes adherent to the gland beneath,—slight œdema, from serous effusion in the cellular membrane, precedes "bogginess," from sero-purulent infiltration into it and into the gland—and fluctuation, from concentration of the fluid into one chamber, follows.

In the stage of "bogginess" it is often hard to say whether there is matter or whether there is not. A careless or an inexperienced surgeon will often hastily decide that there is, and plunge his lancet into the swelling. The sign of only a little blood and a trifling quantity of sero-purulent, or merely serous, fluid, surprises, perhaps mortifies him.

Even when fluctuation is perceptible, it does not follow that the fluid is purulent. I have often seen it more allied to serum than to pus, and we sometimes find sero-purulent fluid in the cellular membrane and in the superficial part of the gland, while a little pus is formed in its interior. I mention these circumstances, partly because they tend to moderate precipitancy, and partly because they explain many of the reputed instances of absorption of buboes in a state of suppuration. In the majority of such instances, it will probably appear, on a careful investigation of the facts, that the fluid has been serous or seropurulent.

To pursue the description of the process of suppuration. The fluctuation, at first indistinct, becomes hourly more unequivocal—the œdema and the redness stretch far beyond the limits of the bubo—towards the centre of the swelling the integument grows prominent, is glossy, and thin—*there* the abscess is pointing, there it will burst. For, the thinning or absorbent process proceeds—a small ulcerated aperture is visible—the matter oozes out—the aperture extends, usually in a linear direction, and in that of the fold of the groin—or several apertures may form, and two or more may coalesce—the matter is then discharged more freely, but seldom freely enough—and, according to circumstances, the abscess may fill up, or ulcerated openings in the integument may continue, or sinuses may form, or the gland or the cellular tissue may undergo some morbid modification of structure. But in persons of a healthy habit these cannot be looked upon as common sequelæ of a bubo.

I would observe in reference to them, that obstinate ulcerations and sinuses are more liable to happen if the patient persists in an injudicious amount of exercise, or in venereal or dietetic excesses. A carpenter had a sinus from bubo, in his right groin; it resisted setons, division, and every thing that I could think of, until he totally discontinued his employment. He had been much in the habit of sawing deal planks, with his right thigh flexed, and his knee pressing on the plank. It is a common enough occurrence for debauchees to continue venereal indulgences with sinuses in the groin, and I have seen these refuse to heal, till continence was submitted to. The gland seldom remains in a morbid state, so as to keep up irritation and ulceration in the parts about it, unless the patient is guilty of great negligence or impropriety. When this is the case, the gland may lie at the bottom of the sinus or beneath the ulcer, surrounded, perhaps, with diseased cellular membrane, itself partially disorganized, and acting like a foreign body. Under such circumstances, fresh attacks of inflammation, and fresh abscesses, may be looked for.

Sloughing.—The inflammation must be very violent, or, what is more likely, the patient or the surgeon much to blame, when either the integument or the gland sloughs. Some degree of sloughing of the skin is not uncommon in patients of the lower class, who are often, from inadvertence or necessity, negligent of their disorders. I once saw the gland slough out completely. A young gentleman, of a full habit, had a simple bubo from excoriation of the inner prepuce. He ate and drank as usual, and suppuration threatened. In spite of my remonstrances, he went out for a hard day's hunt. The inflammation became excessive; matter collected rapidly. I opened the abscess early, but the gland and a good deal of cellular membrane came away as a slough.

Such is the history of bubo, as we meet with it in persons of a healthy habit. It is only requisite to add, that extreme consequences, such as I have touched on, are but rarely seen.

Bubo in a scrofulous habit.—It would be tiresome to go *seriatim* through the phases of bubo in a strumous subject. The *differential* characters are the only ones that I need glance at. Of course I would not be understood to imply, that in every scrofulous person bubo will assume peculiar features. No such constancy is observed in disease. In many an individual who displays the lineaments of scrofula, a bubo will appear and disappear, as it does in the seemingly healthy. But the scrofulous, and, *à fortiori*, those who exhibit the diathesis most strongly, are more prone to the modifications I am about to mention, than they are in whom no such diathesis is evident. No better proof can be offered for much that is generally admitted in pathology. Perhaps the following conclusions will not be found very wide of the truth :—

1. Persons of a decidedly scrofulous habit are particularly prone to bubo, and the tendency is to affection of several glands.

2. Bubo, when it occurs, goes through its stages with extreme dilatoriness.

3. Resolution is much less frequent than in the healthy. Induration is very common. Suppuration is common too.

4. When suppuration has occurred, the following condition of the parts is apt to supervene. A considerable swelling occupies the groin, sometimes pretty uniform, more frequently irregular upon its surface; the integument is of a bluish, and variegated, or, rather, of a brick-dust red: on pressure, the swelling feels remarkably boggy, elasticity, however, predominating in one part, œdematous pitting in another. Amidst the "bogginess" and tumefaction, hard lumps may be distinguished, evidently indurated glands: the tenderness is usually inconsiderable, and the seeming amount of disease contrasts strongly with the general absence of pain. If the suppuration has been recent, there are ulcerated apertures, of greater or less size, leading, perhaps, to an exposed gland: if the case is more ancient, those apertures may have closed completely, or, which is more common, they have ended in sinuses, generally leading to a gland altered in its structure. The discharge, when there is any, is thin, and I have seen it curdy. There is a strong disposition to repeated and partial attacks of suppuration. The duration of this morbid state is always prolonged, and sometimes to a great extent. A few months ago, I saw a gentleman in whom it had existed for a year and a half. And we cannot wonder at this, when we reflect upon the tediousness of a similar affection of the cervical glands, more favourably circumstanced as in many respects they are. At last, however, under proper treatment, or propitious

changes in the system, the swelling subsides, the sinuses close, and enlargement of the glands diminishes or disappears.

Bubo in a cachectic habit of body.—The circumstances under which we see cachexia most frequently, at all events in the middle and the upper classes, are those which result from the injudicious administration of mercury. It is not always the mere quantity of mercury that is injurious ; for an amount that seems to agree with one person, will exert its deleterious action on another. The time, and the mode in which it is given, the patient's habits of life, and, above all, his idiosyncrasy, are elements which materially affect the results. It is generally believed that the scrofulous diathesis is peculiarly prone to suffer from mercury, and no doubt this old opinion is founded in truth. But inadequate or improper nutriment exerts a very sensible influence, and intemperance plays a prominent part. Hence it is, that cachexia is most frequently observed in the lower orders.

The cachectic bubo is characterized by the predominance of the suppurative and the ulcerative processes, and by a marked tendency to phagedæna or to sloughing.

Suppuration, when it occurs, is usually extensive ; the skin is blue, and disposed to be widely thinned and undermined ; the cellular membrane is involved to the same or a greater degree, the absence of the limitations to abscess in a healthy person being marked ; the pain is frequently severe, although it is occasionally inconsiderable. Unless an opening be made pretty early, and not unfrequently in spite of every precaution, the skin ulcerates or sloughs freely ; a large cavity, with sloughy-looking walls, and with diseased glands, more or less disclosed, is now laid open ; granulations rise feebly and irregularly, ulcerating or sloughing, perhaps, after they are formed ; the edges of the aperture may continue to ulcerate, and look picked and jagged ; or they may ulcerate in one direction and granulate in another ; the surrounding cellular membrane still suppurates irregularly or sloughs, so that sinuses open into the old cavity, or fresh ulcerations form in the skin.

A patient in this state is exposed to phagedæna or to gangrene. Any thing which tends to impair his powers may induce the one or the other ; and mercury, especially, will do so. But sometimes an irritating application has the same effect. The vitality of the parts appears to be too low to be capable of any great and sudden increase of action. If stimulated to that, the phagedænic or the sloughing process is the consequence. I once saw a striking instance of this. A young man in the Lock Hospital had a cachectic bubo, ulcerated, and in a chronic state. The house-surgeon pared the edges of the ulcer. Phagedæna followed ; it spread widely, and deeply too ; the femoral artery was laid bare, it ulcerated, and hæmorrhage ensued ; fortunately, assistance was at hand, and the bleeding was restrained by pressure ; wine and opium were poured in, and the man was saved. An instructive case, which would have taught any one who witnessed it, to beware of meddling much with buboes of this character.

The more usual course of cachectic bubo is to lapse into a chronic state. The cavity granulates to a certain extent, its size being proportionally diminished ; but the granulations are unhealthy, dark, imperfectly organized, disappearing, or even sloughing readily ; the gland is probably still diseased, and often palpably is so ; the discharge is thin, copious, and irritating ; the edges of the sore, either callous or ulcerating fretfully ; the surrounding skin blueish ; and the cellular membrane thickened, or traversed by sinuses, or morbid in some other fashion. Such a state may be well termed chronic, for even with the most sedulous and well-directed attention, it may persist for weeks, or even months, and, without such care, its duration may be long indeed. A man was received into the Lock Hospital, with such an ulcerated bubo in each groin ; the sores had been nearly in the same state for a year and a quarter before his admission, and, after the lapse of five months' residence within the hospital, we could not congratulate ourselves on any great improvement. He was, I believe, (for I lost sight of him,) an in-patient for nearly a year before he could be cured.

But cases of this kind, if properly managed, are curable sooner or later. The granulations put on a healthy aspect ; the diseased structure of the gland is quietly absorbed, or removed by instalments of ulceration or of sloughing, or the gland sloughs away bodily ; the diseased cellular membrane is similarly disposed of ; the sinuses close, or are laid open ; and cicatrization is complete at last.

I think it will be admitted, that these forms of bubo, the simple, the scrofulous, and the cachectic, do present leading characters sufficiently distinctive to justify their separation. It may readily be conceded, without derogating from the general utility of their division, that, in the endless modifications which we witness, of constitution and disease, these morbid types are sometimes blended and confused.

I have hitherto said nothing of the general symptoms, for they require little notice. In the simple bubo they will be more or less inflammatory, and such as wait upon active local excitement. In the scrofulous and the cachectic buboes, the general symptoms represent, of course, the states those names imply. For an account of them, I must refer the reader to the particular articles which treat of them.

Treatment.—If the multiplicity of remedies be indicative of the success with which disease is treated, the treatment of bubo must be most successful. I fear, however, that curability and the number of methods of treatment are too often in an inverse ratio to each other. It has been wittily remarked, that there have been thousands of specifics advertised for hydrophobia, but only one or two for itch.

As much of the complexity in the treatment of bubo is connected with that form of it which accompanies venereal sores, it will not be necessary, in the present instance, to allude to remedies which appear to refer more particularly to *it.* They can be discussed more satisfactorily, when syphilitic bubo is described.

The treatment of bubo is, of course, divisible into general and local.

The *general treatment* must necessarily vary as the bubo occurs in a healthy, a scrofulous, or a cachectic habit. When the bubo is of a healthy character, the general treatment is simple enough. Rest, low living, in the inflammatory stage, aperients, and saline medicines are the only measures that are usually required. Some surgeons have recommended general bleeding, but the cases which call for it must certainly be rare. If an abscess forms and is opened, a more generous diet, the cessation of antiphlogistic discipline, tonic medicines combined with regulation of the secretions, and in some cases change of air and passive exercise, are the indications to be followed. As a general rule, rest is advisable before suppuration and after it. I have, however, on two or three occasions, seen sinuses heal under exercise, which would not heal with repose ; this is unquestionably the exception.

The general treatment of the scrofulous bubo and the cachectic, is the same as that of other scrofulous and cachectic symptoms, and will be amply discussed at a future opportunity. Perhaps, however, I may be permitted to observe that, in the scrofulous bubo, I have found full doses of the liquor potassæ, combined with sarsaparilla, of most benefit, either when the glands have been merely indurated, or the suppuration has not been extensive. The liquor potassæ, if given in quantity, is apt to depress persons of lax fibre, pale complexion, and weak habit. It generally agrees better with the ruddy, and with those of stout make, and phlegmatic temperament. As a medicine, it will not do to push it without watching its effects. Steel, in its various forms, is on the whole most applicable when suppuration is or has been abundant, and the boggy state of cellular membrane is combined with diseased glands, and with numerous sinuses. Iodine, so far as I have seen, has not been productive of such marked advantage as the liquor potassæ, sarsaparilla, and steel. The iodide of potassium, however, in conjunction more especially with sarsaparilla, is at times highly beneficial. It would seem to exert a more decided influence on cachectic ulcerations and diseases of the periosteum and bones, than on scrofulous affections of the glands. The cachectic bubo demands much care and discrimination in its general treatment. But as the subject of cachexia will come more legitimately before us hereafter, it would be premature to discuss it at present.

Local treatment.—This will vary materially, as the bubo is in its first, or formative stage ; in that of induration ; of suppuration ; or of ulceration. And the *kind* of bubo, whether simple, scrofulous, or cachectic, will also tend to modify it.

When we find a bubo in its first stage, we are naturally anxious to promote resolution, and, generally speaking, the attempt is persevered in until it succeed, or it is clear that suppuration is occurring.

If the tenderness is considerable, leeches should be applied, to the number of ten or twelve, or more, and the bleeding from the bites should be encouraged. I have thought that leeches were of more benefit, when placed around than on the inflamed glands. The leeches may be repeated, if the inflammation continues, or augments, and if they seem to be of service ; for sometimes they aggravate the tenderness and swelling, and obviously disagree [1]. In scrofulous and cachectic patients, leeches must be used more sparingly, or even avoided altogether. The amount of leeching may be regulated by the quantum of constitutional vigour, of local inflammation, and of benefit derived from the first experiments.

So soon as the bleeding from the leech-bites ceases, or, in slighter cases, when leeches are not called for, evaporating lotions are, generally, the best applications. The most eligible form of evaporating lotion is one composed of the liquor plumbi, some spirit, and water. This should be used in the most effectual manner possible [2]. Cold applications, however, disagree with some persons, and more particularly with the scrofulous and the cachectic. Hot fomentations, or a poultice, suit them better, and not only are more grateful, but more effectually favour resolution.

These means prove successful in the majority of instances. But they occasionally fail, and suppuration seems impending. Under these circumstances, other measures have been more or less recommended. These essentially consist in exciting irritation on the surface. This may be done, and, I believe, is best done, by a blister, either in its ordinary form, or in that of the liquor lyttæ. I have, on several occasions, seen a bubo apparently *certain* to suppurate, resolved by one or two blisters. The nitrate of silver has been used for the same purpose, by the late Dr. Wallace, of Dublin—and the sulphate of copper, the chloride of zinc, the tincture of iodine, the bichloride of mercury, &c., have been employed with the same view. When I come to syphilitic bubo, I shall detail these methods more fully, their advocates having mainly directed them against that form of the complaint[1].

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[1] It has been recommended to employ what is called "permanent leeching," that is, relays of leeches, a fresh set being applied, so soon as the bleeding from the previous set begins to flag. In this way, the leeches are kept at work for twelve hours, or more. Remedies of this description are more easily managed in hospitals than in private practice.

[2] Many other refrigerating lotions, and even ice, have been employed.

Supposing resolution not accomplished, the bubo may pass into the indurated state, or it may decidedly suppurate.

And first, let me speak of the *local treatment of the stage of induration.* A bubo may almost commence with this, the inflammation having been too inconsiderable to deserve attention. Leeches and cold lotions are generally useless, or worse. Warm applications, more particularly poultices, are occasionally beneficial, and a chronic bubo will now and then subside under incessant poulticing, which has resisted more active measures. Perhaps what are called discutient plaisters, act more by maintaining warmth and moisture than by any more recondite virtues; and the mercurial plaister, the iodine plaister, the emplastrum ammoniaci cum hydrargyro, have all had their patrons, and have all been of service. Stimulating liniments and ointments, such as the ointment of the iodide of potassium, of mercury, of the tartar emetic in a weak form, may be resorted to. And decided irritation of the surface by the tincture of iodine, by the nitrate of silver, by blisters, &c., is frequently very desirable[2].

So far as my own observation has gone, the best method of treatment has consisted in counter-irritation, succeeded by the iodide of potassium, or mercurial ointment, and, by the application, at last, of some plaister spread on very thick, soft leather.

The indurated bubo has been treated by compression. I have tried, and seen it tried—sometimes with advantage, often with none, in one or two instances with bad effect. It is not very easy to apply compression *well.* It is apt to be laid on too much or too little, and the patient does not relish the restraint. Compression is probably one of the many remedies that has been over-praised.

Compression has been also recommended in the first stage of bubo, even though some little inflammation be present. M. Ricord, I believe, is the principal patron of it. He founds the practice on the fact to which I have before alluded, that bubo seldom occurs on the side on which a truss is worn. But, granting this, it does not follow, that, because compression may prevent the occurrence of inflammatory swelling, it will therefore remove it when it has occurred. The phenomena of inflammation under fasciæ, rather lead to the contrary conclusion. I must admit, however, that I have no experience of compression in such a case.

Some French writers, MM. Cullerier, Ratier, Ricord, and others, speak of "scirrhous" induration of the inguinal glands, as if it were a common consequence of bubo. But the term, scirrhus, must be loosely understood to warrant any such statement. True scirrhus is rare indeed, as a result of inflammation of the glands in question.

In spite of all that we can do, indurated bubo will occasionally remain for a great length of time, and, from some fresh source of irritation, inflame again and suppurate. Suppuration, in such a case, is far from undesirable, and the surgeon may do his best to promote it. A blister will sometimes flog up the indolent action, and determine the formation of pus.

Local Treatment of suppurating Bubo.—When resolution is clearly unattainable, the best plan is to accelerate suppuration. The blister, which, perhaps has been applied with the view of dispersing the enlargement, will generally, if it fails in that, expedite, and, I think, limit the suppurating process. We must then resort to fomentations, and poultices of linseed meal, the oftener applied, and the hotter, the better. Suppuration advances, more quickly in the strong and the cachectic, more slowly in the scrofulous; and it becomes a question, and a much disputed one, how the abscess shall be opened. The following are the points which require consideration:—1st, Is it better to make an artificial, or to wait for a natural opening? 2, Is an opening by a cutting instrument, or one by caustic preferable? 3, Shall we practise an early opening or a late, a small or a free one?

1. As a general rule, surgeons are agreed on the impropriety of allowing the abscess to give way spontaneously. It is, therefore, unnecessary to dilate on the disadvantages of that. But there are cases in which, I believe, the rule may be broken through with benefit. In the scrofulous bubo, where small foci of suppuration are often forming, and the cellular membrane is a good deal implicated, the case often does better without the lancet than with it. The frequent incisions worry the patient, and seem to irritate the skin. I would not be understood to say, that, in the scrofulous bubo, the abscess ought never to be opened, but merely that the *small* collections that go on forming for a length of time, are frequently best let alone, and the same caution will now and then apply to the cachectic bubo.

2. There are few cases in which an opening by caustic is advisable, or even justifiable. If the skin is not extensively thinned, no reasonable pretext can be urged for caustic; and if it is, the surgeon must be ill-acquainted with the resources of either nature or art, who pronounces it irrecoverable. If a judicious opening relieves all tension, and properly evacuates the matter, the thin blue skin, even of the cachectic bubo (for few would dream of employing caustic in the simple or the scrofulous varieties), will revive marvellously under generous diet, and stimulants, and tonics, accompanied with appropriate local management.

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[1] In the interim, I would strongly recommend to the reader, Mr. Parker's work on the Modern Treatment of Syphilitic Diseases. It gives an excellent view of the practice of the French school, and is written with care and judgment.

[2] I have found the following useful on this and similar occasions:—℞ ung. hyd. fortioris, ℥i — Ant. Potassio-tart. ʒi—Iodinii, gr. x. ad xv. M. ft. unguentum. To be rubbed in night and morning, until it produces a sero-purulent discharge from the surface.

It would, perhaps, be going too far to say, that the opening a bubo by caustic is never proper, but certainly it is very seldom so. Painful in its use, it destroys skin which, in all probability, might by other means have been preserved. Nor can it be looked on as absolutely safe, for in states of system predisposed to phagedæna, which the cachectic are, the irritation excited by the potassa fusa, or by any other strong escharotic, might give birth to that formidable affection.

3. Early openings and late ones, small and large ones, have each in turn had their advocates.

I confess that my predilections are rather for early openings. Even in the stage which precedes the perfect formation of pus, and its collection into a single cavity, a moderately free opening has frequently appeared to me to check the progress of the bubo, and materially limit its extent. And several considerations seem to be in favour of this opinion ; for, if the bubo depend upon a single gland, it is difficult to understand what objection can lie against an early incision, one that only anticipates what *must* come a little later ; and, on the other hand, if several glands are affected, to delay operating would be to offer a premium on a large abscess, a troublesome sore, and a protracted cure, when two or three small incisions might economise both skin and time. Of course there is a medium in this, as in all things, hard to hit upon paper, and determined only by that practical experience and observation, for which no rules can be given, and which no directions can create. But if, in enlargement of a single gland, there is a part of fair dimensions with evident fluctuation ; or if, in enlargement of several glands, there be more than one such, too widely separated to become easily confluent, I would advise, and have never seen cause to regret an opening. By delaying this too long, the abscess, which is partly formed at the cellular tissue's expense, is apt to become unnecessarily large, integument is endangered, and the subsequent reparative stages are protracted.

In the scrofulous bubo we need not be in any hurry to operate. The amount of suppuration is seldom so great as it seems, and extensive swelling and redness often end in a very small abscess indeed. I have already observed that nature may frequently, in this form of the affection, be left very much to herself.

The dispute on the superior eligibility of a large opening or a small one, is settled in a great measure by the settlement of that on an early opening or a late one. If we make an early opening, we cannot well, or, at all events, we need not make a large one ; and, if we make a late opening, it would be absurd to make a small one. On this point, therefore, I may be excused from dilating. But the mode of making the incision deserves a little more attention notwithstanding. It has appeared to me that something has been gained by attending to the following circumstances :—*First*, to make the puncture in as dependent a part as possible of the general or particular cavity laid open ; *secondly*, so to direct the incision that the necessary movements of the limb may not pull the edges asunder ; if the abscess is very small, a vertical incision answers best ; if larger, it should be oblique, forming an angle of forty degrees, or thereabouts, with the ligament of Poupart.

It not unfrequently happens, that a cavity of some size presents, as it were, two chambers, connected by a more constricted portion. The skin is thin, and an opening is necessary in two places, separated by a greater or less interval from one another. The intermediate part of the cavity does not close with readiness, and it may be requisite at a later period to lay the two openings into one. But I have often gained time, and saved skin, by passing a seton of calico or linen rag, in the first instance, from one opening to the other. This plan commonly answers very well; if it fails, we can but throw the two openings into one at last.

I have applied the seton to the treatment of a large cavity, and with very good results. A small vertical incision may be made at the inferior and pubic confine, and another on the opposite side. A seton may then be passed from one to the other. Granulations fill the cavity, and the skin between the punctures is preserved. This method is to be preferred where the patient is anxious to avoid a large scar, or where, from the size of the cavity, we are unwilling to sacrifice skin. Of course the seton tape is merely passed from the one opening to the other, not tied so tight as to cut through the integument.

In the cachectic bubo the incisions must often be more free than in the other forms ; the cavity being larger, and the skin more undermined. The surgeon should, on this account, take care not to wait too long before he has recourse to the knife.

After the opening, fomentations and poultices should be employed as before, until granulations have freely sprung up. Stimulating injections should then be made use of ; and, if the cavity is shallow and secretes little, the water dressing, so warmly patronised by many surgeons of the present day, will agree. But, although it is not the fashion to praise poultices, I must confess that I have seen, or thought that I have seen them agree as well as other applications, if not better. A light bread poultice, made with a solution of the chloride of lime or sulphate of zinc, instead of with plain water, and enclosed in a muslin bag, can be bound gently, or hung, against the aperture, and keeps it moist and open. Injections, or the lunar caustic, stimulate, at the same time, the granulations within ; and, under this plan, as much progress is made as under any other, if indeed there is not more.

The scrofulous bubo, in the stage of suppuration, may sometimes be beneficially treated by compression. But care must be taken not to block up any openings ; and compression in most cases of subcutaneous suppuration is a two-edged sword. It does harm as often as good; so, at least, it has seemed to me. I have seen benefit in the scrofulous bubo from the sulphate of zinc poultice, from the goulard poultice, and from cloths saturated with the solution of chloride of lime or of sulphate of zinc, applied to the groin, covered with oiled silk, and held on by a light bandage.

The cachectic bubo, when the opening in the skin is large, the cavity exposed freely, and its surface irritable, is best treated by the carrot poultice, or the poultice of bread and aqueous solution of opium. If the parts are simply languid, the stimulating applications, such as the compound tincture of benzoin, the balsams, the melted compound elemic ointment, &c. may be poured in, while poultices are still kept on; but if the parts are irritable, stimulants are apt to disagree, and the aqueous solution of opium or belladonna answers best.

When ulcerations have supplanted the abscess, and its opening, they must be treated in accordance with the principles which regulate our management of ulcers in their various forms. It would be out of place to enter upon these at present.

Local treatment of sinuses.—If these are immediately beneath the skin, and of moderate extent, the simplest plan is to lay them open. But if very long, a seton is preferable; or they may be incised to a convenient extent, and a seton passed through the remainder[1]. If a sinus passes deep, as it sometimes will, it cannot be laid open properly. Injections of a *very* strong solution of the nitrate of silver, or, as Sir Benjamin Brodie has advised, the introduction of a probe, coated with a thin film of it, or a bougie smeared with the nitrate of silver ointment, have all been found to succeed.

But a sinus will often lead to a diseased gland, or to altered cellular tissue. It is generally useless attempting to heal a sinus of this sort, and it would be worse than useless if we could heal it, for fresh suppuration would ensue. When the gland or the cellular membrane is removed, or recovers itself, the sinus will do well under the ordinary remedies.

Local treatment of diseased gland.—It is in the scrofulous and cachectic buboes that a portion, which is common, or the whole, which is rare, of a gland will fall into a morbid state, and will be hardly able, if at all, to regain its natural organization. Such glands may be seen in the shape of pale-coloured projections at the bottom of suppurating cavities, or the cavity may be partly formed at their expense, or, lastly, such a gland may form the termination of a sinus. Sometimes, at the bottom of a cavity an entire gland is so disorganized that it sloughs away, or may be pulled away, but more frequently it is firmly fixed, and either bits only are separated, or, what is quite as frequent, the gland gradually regains its normal state.

Formerly these glands got very rough usage. They were rubbed with potassa fusa, or cut out, or had troches thrust into them, all very objectionable proceedings, evincing a disregard of the natural resources of the system, and the offspring of bad general treatment. Under the employment of tonics generally, and of poultices with moderately stimulating applications locally, these glands in time recover themselves, and in a shorter time, too, and with less hazard than if they were officiously meddled with. If a gland lies loose, it is well to remove it, or if a piece of it forms an obvious slough, that may be abstracted too. But beyond this the surgeon should be chary of venturing.

If the cellular tissue is decidedly diseased, an incision should be made into it, and the slough, if there be any, got out. If there is no actual slough, the usual dressings will induce more healthy action.

I believe that all the more important circumstances connected with bubo, not dependent on the absorption of a specific poison, will be found in the preceding article. This plan of viewing it in a more insulated manner than is generally done, is calculated to exert a beneficial influence upon our practice; for many, if I may be allowed to say so, are too prone to look on bubo as a syphilitic symptom, and the common ideas with regard to "sympathetic bubo," are, to say the least of them, vague. When *syphilis* comes before the reader, he will find such a notice of the bubo dependent on that morbid poison, as will put him in possession of what is known upon the subject.

(*Henry James Johnson.*)

BUBONCELE, from βουβών, the groin, and χηλή, tumour, *Inguinal Hernia*, or *Rupture*, Eng., *Leislenbruch*, Ger. The tumour while confined to the groin is so named, and owing to the greater size of the inguinal canal in the male, is much more frequent in that sex. If the rupture descends into the scrotum, it takes the name of scrotal hernia. See Hernia.

BUNYON, See Bursæ Mucosæ.

BURNS and SCALDS (Burn, Goth. *Brinnan, A. S. Bernan, byrnan;* Dut. *Bernen, burnen;* Germ. *Brennen;* Sw. *Braenne;* Fr. *bruler;* It. *bruciare;* Lat. *urere;* Gr, καίω.—Scald, Fr. *Eschauder*, from the It. *Scaldàre, calida urere*, q. d. *excalidare*, to burn with hot (water). By burn or scald is signified every lesion, more or less considerable, produced upon a living part by the influence of elevated temperature ; the former implying the action of dry, the latter that of humid heat.

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[1] If a sinus runs down, as it often does, in the commissure of the thigh and perineum, the surgeon should hesitate before he lays it open. I have, more than once, seen a most troublesome line of ulceration from its division. Nor is it needed. An opening at the bottom of the sinus and a seton prove sufficient.

The living tissues are variously affected by the influence of caloric. If that be moderate in degree, an equilibrium may be established without inconvenience. A genial warmth is felt, whence follows a mild reaction, rather favourable than otherwise to a healthful condition. Should the heat be more intense, the sensation occasioned by it ceases to be pleasurable, nay amounts to positive pain. If still more excessive, it penetrates the tissues, elevating their temperature, and changing their organic relations. Nature, in order to counteract an elevation of temperature incompatible with their integrity, directs an afflux of fluids from all sides towards the centre of irritation. In other words the following physiological phenomena ensue—attenuation of the circulating media, dilatation of the minute vessels, and a modified state of the local irritability, which, under ordinary circumstances, resists the circulation of red blood in the white vessels. The blood thus impelled into those delicate tubes, by the stimulus of caloric, becomes slower and slower in its course, till it stops. We have, therefore, stasis, redness, swelling, and, from compression of the nervous web, pain is developed. These together constitute inflammatory irritation. When the action is prolonged, or exalted, the animal tissues being, from their organization, no longer capable of tolerating its influence, give way. The force of cohesion is weakened, the living resistance destroyed, and vitality annihilated. New combinations are formed between the organic elements. Thus sphacelus results.

In the present article we can consider only the results of the influence of heat on the vital textures, without noticing the congenerous effects produced by various chemical substances. These, while they corrode and penetrate the tissues, effect their decomposition in a different way. The remarkable facts concerning spontaneous combustion of the human body, we shall not discuss at present, as we conceive them to be fair matter for separate consideration.

The effects of concentrated caloric are nearly the same whether transmitted by radiation or immediate contact. That is, whether the living tissue be removed to a certain distance from, or placed in direct communication with, the hot body. We rarely find, however, as M. Bégin[1] observes, that radiant heat, whatever be its intensity or violence, if emanating from a remote source, occasions severe burning ; because the subject speedily roused to a sense of impending danger, by the pain produced, is naturally led to withdraw himself from its influence, ere any extensive mischief can arise. Dupuytren asserts, indeed, that insolation, especially in tropical climates, is fraught with imminent peril, by its causing high inflammation, followed by gangrene, and proving fatal on the fourth or fifth day. It appears to us, however, that considerable weight is to be attached to the peculiar influence of climate, in calling into existence and activity morbid predisposition. It is abundantly demonstrated, that under certain circumstances, not easily explained, the most trivial injuries induce inflammatory disease, equally alarming from the intensity of its symptoms, and the rapidity of its course. The consequences of insolation shall be subsequently described.

If, generally speaking, the local effects of irradiation are inconsiderable, far different are these in the case of flame ; which is remarkable not only for its suddenness of action, but likewise for its causing the parts it attacks to contribute to the process of combustion. Thus animal matter, exposed to its scorching influence, parting with its water, becomes dry and parched, assumes a crisp, coriaceous consistence, and emitting a crackling sound, is promptly consumed. While the work of dissolution is going on, empyreumatic oils, and inflammable gaseous compounds, are generated. The flame, thus supplied with fresh fuel, augments in violence, and pursues further and further its ravages. Every one knows with what prodigious, and often fatal rapidity, clothes, particularly bed-clothes, burn. In this manner, the entire surface of the body is frequently reduced to an incinerated crust, especially in the instance of helpless infants, or of individuals labouring under the stupor of intoxication, or the coma of apoplexy.

The fleeting burst of flame, evolved from the combustion of inflammable gases, as the sub-carburetted or sulphuretted hydrogen, pent up in close chambers ; from the vapours of alcohol, ether, naphtha ; from the deflagration of gunpowder, gives rise to burns, not merely serious from their extent, but ofttimes from their depth.

Certain highly combustible substances, such as phosphorus, sulphur, potassium, resins, which pass into fusion, and at the same time undergo chemical changes, occasion very severe injuries. The pain caused by burning potassium is extreme, as it combines the energies of the actual and potential cautery.

But of all the causes of burns, one of the most efficient is the direct contact with the living tissue of heated substances. The severity of lesion depends on the following circumstances—the nature of the agent, whether solid or liquid—the quantity of free caloric it contains—the duration of application—and the part of the body involved. The promptitude, intensity, and profoundness of the impression produced, is directly as the temperature of the medium on the one hand, and as its capacity of disengaging, conducting, and transmitting caloric, on the other.

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[1] Article Brulure in Dict. de Médécine et Chirurgie Pratique. Paris, 1830.

Many intelligent writers on this subject have erred, in entertaining the opinion, that the intensity of the lesion is proportionate to the relative capacity of the agent for heat. The principle is in direct contradiction to facts. Thus, for example, it is proved by experience, that a mass of copper, under like circumstances, will occasion a more severe burn than a mass of iron. Yet iron possesses a greater specific heat than copper, in the ratio of 11 to 9; wherefore, according to their hypothesis, the iron should be the more energetic of the two, which is not the case.

The true explanation of this apparently unaccountable phenomenon, can only be deduced from the circumstance, that different substances have different powers of conducting heat. And on referring to the ingenious and accurate researches of Richmann and Ingenhausz, since confirmed by Despretz and others, it will be seen that as regards this physical property, copper stands to iron in the ratio of 8 to 3[1].

It is therefore to the density, on the one hand, to the conducting power, and consequent facility of transmission, on the other, that we are to ascribe the variations evinced by different substances, in abandoning their heat to the bodies with which they come in contact.

Solids, especially the metals, from their superior density, and great conducting power, produce instantaneously deep and extensive burns. The thermometric elevation is, however, of necessity, the most important element; hence the burn occasioned by iron, at a dull red heat, is superficial, compared to that produced by the same metal at incandescence.

Liquids being of variable density and temperatures, occasion scalds, more or less grave. Thus fixed oils, melted tallow, rich soups, concentrated saline solutions, act with more energy than boiling water; whilst ether, alcohol, caoutchoucine, from their great volatility, produce, if any, merely superficial scalds. We must, however, hold in mind a circumstance, which tends to render the action of the former class of agents more violent than that of water, independently of elevated temperature; namely, their natural tendency to adhere to the skin, over which the latter merely glides; for a burn or scald is profound in proportion as the contact of the agent producing it is abiding.

Since pain is developed under the influence of innervation, it is manifest that that which accompanies an injury from burn will be proportional rather to the imperfection or slowness of its accomplishment, than to its amount, or the number of parts interested. Hence, the greater the rapidity of the act of disorganization, the less does the patient suffer. The remarkable instance related by Cheselden, of the person who had his arm suddenly wrenched from the trunk by mechanical violence, and, unconscious of pain, was not aware at first of what had befallen him, confirms the inference just drawn. Dupuytren has furnished a somewhat parallel case, where a like apathy was evinced under a hardly less grievous injury. A young man, while walking across a foundry, inadvertently placed his foot in the channel destined to convey away the fused metal. The molten current rushing suddenly forth, enveloped his limb in part, and he withdrew it bereft of the foot and lower portion of the leg. He expressed himself as having scarcely experienced any pain whatever; and some time elapsed ere he was conscious of the mutilation to which he had been subjected.

Burns are more grave when they occupy surfaces usually protected by dress, and where the epidermis is thin and delicate, as the neck, breast, or abdomen, than when parts habitually in communication with surrounding objects, of which the epidermis is thick and indurated, are concerned. It is a familiar fact, that farriers, blacksmiths, and other artisans, used to rude and laborious occupations, have the cuticle of the palms of the hands so hard and callous, as to enable them to seize ignited metals, and the like, with impunity.

Women more frequently fall victims to burns than men; a circumstance to be ascribed to the slighter texture of their garments, which are loosely applied to the body, and apt to catch flame. Certain trades may be cited as predisposing conditions to injuries of this kind, as that of blacksmiths, founders, and plumbers.

Among the accidental causes may be reckoned, apoplexy, epilepsy, inebriation, asphyxia, sleep, when in the proximity of fire, and every condition, in short, that tends to deprive man of the use of his intellectual faculties, or to prevent the due exercise of that vigilance necessary towards self-preservation. Of all those enumerated, the state of profound sleep is, perhaps, the most common predisposing condition.

In Paris, where the lower classes are obliged to economize fuel, fatal accidents from fire often occur, and chiefly among old women Their body-clothes take fire while partially asphyxiated by the emanations from the burning charcoal contained in their *grilles* and *chaufferettes*, which gradually deteriorating the atmosphere of their narrow ill-ventilated chambers, unfit it for the purposes of animal life.

Series of pathological effects produced by heat on organic textures endowed with life.—Writers on surgery are divided as to the number and arrangement of the different degrees of burns. Heister reckoned four; in the first, there is heat, followed in a short space of time by an eruption of vesicles; in the second, eruption of vesicles immediately consecutive to the application of the burning agent; in the third, destruction of the skin, subjacent adipose tissue, and muscles; in the fourth, destruction extending to the bones. Callisen adopted

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[1] See Despretz's Table in Dr. Ure's Dictionary of Chemistry, article "Caloric," p. 262.

Heister's classification. With certain modifications it is the one at present generally received by the German surgeons.

Boyer, after the example of Fabricius Hildanus, reduced them to three. In the first degree, the effect is confined to a lively irritation, altering the condition of the fluids in the part, whence results an inflammation of an erysipelatous character. If the heat applied be more intense, there is irritation, followed by the formation of phlyctenæ, causing a denudation of the nervous papillæ of the cutis vera ; thence succeeds superficial ulceration, analogous to that produced by the application of a blister. This is the second degree of burn. Finally, if the action be still more powerful and prolonged, it disorganizes the part, which, according to the nature of the efficient cause, is either covered with an encrusted eschar, or, remaining moist, assumes a greyish yellow aspect. In one or other case vitality ceases [1].

M. Marjolin, the present professor of *pathologie externe* at Paris, looking only to the nature of the lesions occasioned by burns, divides them into two orders,—*inflammation*, and *immediate disorganization.*

It remained, however, for the observant genius of Dupuytren, dissatisfied with preexisting arrangements, to contrive and substitute in their stead one no less comprehensive than exact ; pointing out those shades of disorganization in the skin and subjacent parts, which the preceding systematists had confounded together in their third and fourth orders. The several gradations of pathological change, it professes to establish, are in strict conformity to the extent of alteration the vital tissues have undergone. Each degree is distinguished by phenomena peculiar to itself; and these, it is of importance to bear in mind, not merely as relates to practice, but also in reference to the prognosis to be deduced, depending on the train of concomitant accidents, and the deformities and mutilations which may be left behind.

The arrangement we shall adopt, is that of Dupuytren, modified, however, in some respects, agreeably to the recent discoveries of physiologists concerning the structure and functions of the skin. It embraces six degrees.

In the first degree, which is the erythematous, there is no disorganization of texture, but a modification in the vital properties of the part, inducing simple redness of the skin, due to the transparency of the *horny texture ;* for it is never seen red, unless when the epidermis is very thin. This rubefaction disappears momentarily with pressure, whereby the pain is augmented. It is to be distinguished from erysipelas by its mode of development and sequelæ.

In the second degree, there is an evident change in the organic relations of the part. The lymphatic vessels of the sudoriferous canals, and of the excretory tubes of the mucus, are ruptured, albuminous serum exudes, which by accumulation, elevates the entire *horny tissue*, or epidermis. In other words, the increased heat attracts the blood to the erectile tissue of the derma, which frees itself thereof by an abundant secretion ; and thus determines the formation of phlyctenæ.

In the third degree of burn, the whole epidermic layers are destroyed, including the *diffluent horny matter*, or *corpus mucosum* of Malpighi, together with the papillæ, or conoid eminences formed by the nervous extremities, and enveloped by the deep epidermic layers.

The fourth degree comprehends the destruction of the epidermic layers, the fibrovascular tissue constituting the derma, and a portion, more or less, of the immediately subjacent cellular texture.

The fifth degree comprises, in addition, the different strata indicated in the preceding to a great number of parts lying deeper, such as aponeuroses, muscles, tendons, nerves, veins, arteries, down to the very bones.

Lastly, the sixth degree is that in which there is complete combustion of a part, or of the totality of a member or organ. Of this, local death is the immediate and necessary consequence.

We shall now consider these respective orders more at large.

The first or erythematous degree, is often so very slight, as scarcely to deserve the name of injury. It is commonly induced by the emanations of radiant heat, by hot air, water, or vapour, or by the extrication of caloric from solids, at an elevated temperature. Our organs furnish us, in most cases, with very delicate tests of the increase or diminution of heat. Hence the skin subjected to an undue degree of heat, becomes speedily hot and red. The erubescence thus produced, varies in intensity from a pale rosy tint to a deep violet ; it is not circumscribed ; and disappears, as we said above, under pressure of the finger. The capillaries, or rather the *intermediate vessels* [1] of the derma are injected, as shown by slight concomitant intumescence. There is a smarting or burning sensation referred to the spot, which induces the patient to seek instinctively the impression of cold. In general the pain and erythema, are coetaneous. However there often remain a morbid sensibility and uneasiness in the part for days after the redness has subsided.

The duration of these symptoms, is from a few hours to two or three days. There sometimes follows a desquamation of the epidermis, in the form of furfuraceous scales. In the milder forms this seldom occurs, the capillary system being restored to its normal condition, without leaving any trace behind.

It is essential to ascertain the efficient cause, ere we can determine the precise degree of injury. A knowledge of this point will moreover prevent our confounding the accident with erysipelas, to which it bears some resemblance.

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[1] Boyer, Traité des Mal. Chir.

[1] Berres, Anatomie der Mikroskopischen Gebilde. Wien, 1836. p. 81.

Although rarely mortal, it is not unfrequent, when extensive surfaces are inflamed, to find the pulse rise, become frequent and full, the tongue red, and phenomena of gastro-intestinal irritation supervene. In irritable subjects high nervous excitement may occur, leading to want of sleep, delirium, convulsions, and even death.

Sudden constitutional disturbance is more particularly observed in the case of powerful insolation, *coup-de-soleil*. When the bare head is some time exposed to the direct rays of a burning sun under certain predisponent circumstances, as after active and continued labour, during deep sleep, during the lethargy of intoxication, it is affirmed that one or other of the subjoined forms of encephalic affection may be excited. 1. Sub-acute phrenitis; 2. High phrenitis; 3. Apoplexy of a congestive type; 4. Delirium with fatal syncope[1]. Dr. Steinkühl, from the results derived from the cadaveric examination of two cases of *coup-de-soleil*, has ingeniously attempted to demonstrate that death is caused by asphyxia from gorging of the lungs with blood, and suspension of the heart's action[2]. These violent symptoms have led many to view insolation of the head and face as presenting a special malignity of character, but analogous results are often produced by erysipelas of these regions provoked by other causes: post mortem examination disclosing the same vascular turgescence of the membranes of the brain, as is met with in fatal cases of insolation.

The scorching from lightning is sometimes attended with paralytic symptoms, the local phenomena are, a brownish red singed appearance of the skin with partial induration, totally different from the ordinary effects of flame. An interesting case of this nature is detailed by Rust[3].

Some further observations have been collected by Dr. Keyler, in his second number of the Würtemberg Mediz. Correspondenzblatt for 1834. The event is reported to have taken place near Engweihingen, in Germany, in June 1833. Of several persons who were struck, one old man died on the spot, and four were severely injured; in one of these, an adult female, one pupil became dilated; she was seized with loss of consciousness, followed by vomiting, and diarrhœa, which continued two days, together with painful feeling of laceration in the feet; in a second, a middle aged man, partial paralysis of the arms ensued, attended with frequent painful convulsive twitching (like electric shocks) in the extremities. All evinced a sense of great anxiety and oppression; the pulse became slow, ranging from fifty to sixty beats in a minute. The extremities were cold, rigors, and pain in the arms were complained of. The affected parts were the seat of burning heat. They had the aspect of incipient gangrene occupying the epidermis, and in some places the chorion; suppuration took place, and in one case the sore was not cicatrized before six months. They all emitted a peculiar burning sulphureous odour, resembling that produced by rubbing iron and steel together. The clothes were torn in several places, and impregnated with the same odour.

Parts of the body that are always exposed to the moderate but rubefacient action of heat, exhibit irregular brownish marbled patches, as may be seen in aged persons of sedentary habits, who are constantly sitting by the fire. Old French women of the lower classes, it is asserted, have the integuments upon the inner surface of the thighs and legs, speckled to such a degree as to impart a pie-bald appearance, from the constant practice they have during the cold months, of resting their feet upon small clay chafing-dishes filled with burning cinders. For a like reason, workmen employed at forges have their limbs often covered with crusts and ulcers. Such are the effects of continual recurrence of the erythematous degree of burn on the human integuments.

If the action of the several determining causes forementioned be more intense or prolonged, the symptoms are more grave. But the distinctive character of the second degree of burn is the elevation of the epidermis by albuminous serum effused from the exhalant vessels, in the form of phlyctenæ or blisters. These appear almost instantaneously on parts that are fleshy or of a delicate contexture, especially in the case of scalds. They are at first miliary vesicles containing limpid serosity, but speedily coalesce into blisters, varying both in point of size and number. These latter are of a citron-yellow tint, sometimes transparent, sometimes opaque; and augment in volume in proportion to the persistence of irritation. Under protracted irritation, successive crops of vesicles spring up in the vicinity, during the first twenty-four hours from the accident. A rosy-blush, variable in depth of tint and in extent, encircles these phlyctenous groups. Here there are considerable intumescence, and acute burning pain. If the epidermis be ruptured, there issues a quantity of serous fluid, generally limpid, but sometimes of a white or reddish tinge, according to the intensity of the lesion. Upon puncturing a blister, the contained liquid trickles away freely, except it be diffused in cells formed by concrete albumen, when it oozes out, drop by drop. On dividing without detaching the distended epidermis, it soon collapses, but never reunites. After the lapse of a few days, it becomes dry and falls away; and we see in its stead, either a thin delicate layer of new cuticle, or a false membrane, secreting pus. When the cuticle has been torn off at the moment of the accident, or rolled up into a scroll like writing paper, leaving the cutis bare, the contact of air with the inflamed nervous papillae, creates the most acute suffering, and suppuration is almost inevitable. The pain does not remit until the denuded surface is shielded by exudation of plastic lymph, or by new epidermis[1].

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[1] Edin. Med. and Surg. Journ. vol. xxix.

[2] Hufeland's Journal, B. xlix.

[3] Aufsätze und Abhandlungen. Berlin, 1834. p. 44.

Here the skin for the most part, not having sustained any material loss, preserves its contexture, and heals without a scar. Should there have been, however, protracted suppuration from the inferior stratum of the epidermis, otherwise called *corpus mucosum*, exceeding according to Dupuytren the term of fifteen days, the skin will be replaced by new integument. If there be long continued irritation, the part becomes irregularly hypertrophied, and an unseemly cicatrice, like that from an old blister, is the result. Deformity may likewise be produced by ill-directed treatment, or by want of proper care and attention on the part of the surgeon. Under favourable circumstances, it is fully ascertained, that the red cuticular investment first formed over the burnt surface, gradually assumes the natural hue of the surrounding integument[2].

The grades of lesion just considered, are of a fleeting nature. But the *third degree*, in which the vitality and organization of the *derma* are implicated, is of a more serious kind. Here there is a scathing of the epidermic layers, conjoined with that of the delicate and sensitive surface of the papillary bodies. This degree of burn is referrible to the same causes as the two preceding; but their action has been more intense and prolonged, from various accidental circumstances above enumerated, such as asphyxia, epilepsy, intoxication, &c.

The appearance of the disorganized integument differs according to circumstances. When the burn has been occasioned by an incandescent body or burning clothes, patches of a grey, yellow, or dusky colour appear; while with heated liquids, they are white or greyish-yellow. The eschar is commonly tense, elastic, and thin, like a piece of parchment: insensible if lightly touched, though pressure awakens a lively sense of pain. The pain accompanying this degree is less severe than in the two preceding, but greater than in those that follow; while the constitutional sympathy is less where the cutis is charred and killed, than when it is simply exposed.

A familiar illustration of the present grade is furnished by *moxa*, where all the different shades of colour are to be seen blended together.

The burnt surface may present three different aspects, according to the state of the epidermis; which may be destroyed or removed, or elevated into phlyctenæ; or lastly, it may be hard and horny, bound down to, and strangulating in a measure, the subjacent sound textures. In the first instance, the naked surface has a grey or brownish colour. When phlyctenæ are present, they differ essentially from those formerly described, inasmuch as they contain a milky, reddish sanguinolent or brown fluid, extravasated from the *intermediate-vessels* of the *derma*. The puce-coloured vesicle is here an excellent diagnostic mark. As you recede from the centre of lesion, you observe traces of the epidermic degrees of burn; namely, blisters filled with transparent serum, and further off, erythematous redness. The eschar is about the quarter of a line in thickness. The pain, at first often hardly appreciable, becomes in the course of a few days very pungent; inflammation is excited, and in a short time a solution of continuity is accomplished between the dead and the living structures. Hunter attributed the separation to the action of the absorbents, and this absorption he denominated the " true surgery of nature." The period of time required for the detachment of the eschar, varies according to individual circumstances, age, constitution, and the like; as also according to the respective share of vitality of the parts interested. According to Dr. Donnellan[1], from four to six days are indispensable, when the *corpus mucosum* is alone involved; if a constituent part of the chorion be at the same time implicated, eight, fifteen, or even more days will be needed.

On examining the eschar prior to its final separation, it will be found loosely connected with the living surface by numerous nervous and vascular filaments. Traction gives pain as well as division. Hence the propriety of not interfering with these sensitive links. After its removal a superficial sore remains; in which the cicatrizing pellicle proceeds usually from the circumference to the centre.

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[1] In this place it is proper to state, that acute inflammation of the glottis and larynx, resembling croup, has been induced by swallowing boiling water from the spout of a tea-kettle. It appears probable, according to Dr. Marshall Hall *, that the boiling water does not penetrate into the stomach, or even into the gullet, but that its course is arrested by a spasmodic action of the muscles of the pharynx. In passing to the posterior part of the mouth, however, it scalds the epiglottis and glottis, which afterwards become more and more swollen, until at length the *rima Glottidis*, or orifice into the larynx, becomes completely obstructed.

[2] It is deserving of notice, that the application of scalding heat has been resorted to for therapeutical purposes.

The late Baron Des Genettes ‡ recommended as a substitute for blistering-plaister, compresses dipped in boiling water. The substitution, however, as Dr. Donnellan remarks, requires the utmost care. And the difficulty or impossibility of confining the action of the liquid to one spot, ought to render us very circumspect in its use. Deep eschars and tedious ulcers have been known to result therefrom.

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* Dr. M. Hall's Edition of Underwood. London, 1835, p. 364.

† Hist. Méd. de l'Armée d'Orient. 1802.

[1] Précis sur la Brûlure. Paris. 1831.

Sometimes again it originates in insulated points on the middle of the sore. This is always a favourable circumstance, since it denotes a tendency to prompt cicatrization. The cicatrix issues from all points of the lowest layer of the adjacent epidermis, according to M. Breschet[1].

To these layers are added others in succession, until the pellicle has attained the level of the surrounding epidermis. The granulations, improperly called *fleshy*, are insensible. They belong to the epidermic mucous-matter. When cicatrization is finished, the primitive integument is replaced by a new texture somewhat analogous, but still sufficiently different to be easily recognised. It is more dense and less vascular; it is generally destitute of papillæ; and its surface, smooth, arid, and glistening, is traversed by waved-lines and knotty cords. The cicatrix for some time after its formation is red and injected; but ultimately becomes of a dull-white, or at all events of a paler hue than the neighbouring integument, from diminished vascularity, and non-reproduction or modification of certain elements of the cutaneous organ. When it is otherwise, the redness seems to depend on a congested state of the subjacent *derma*, as is very visible through the attenuated and nearly diaphanous scarf-skin. The sense of touch is long preternaturally obtuse in the new formation.

It is to this, the *third degree*, that the greater number of burns caused by the sudden burst of flame from the deflagration of gunpowder belong. They are easily distinguished by means of the black or speckled eschar, owing to the introduction into its texture of the carbon of the powder. In a great number of burns from this substance, a portion of the grains which have escaped combustion, propelled with projectile force, penetrate and lodge in the skin. The bluish black points thence resulting, impart a tattoed appearance to the skin, which is generally permanent, unless great pains have been taken at the moment of the accident to extract each particle.

In the *fourth degree*, which may be considered as the consummation of the three preceding, there is total disorganization of the skin, together with the subcutaneous cellular tissue. The eschar is remarkable for its superior compactness; its thickness, which is from one-and-a-half to two lines or more; its density and its complete insensibility. It seems, as it were, superimposed upon the subjacent parts. In the case of severe scalds it is of a softish consistence, and of a yellow or grey colour; but when the agent is an ignited solid substance, it is uniformly dry, hard, inflexible, coriaceous, brittle, and sonorous, presenting a brown or black colour. Round the margin, where the charring is most complete, the skin seems puckered, whilst the surface of the eschar is depressed, and radiated from centre to circumference. The pain ceases along with the action of the cause; but persists with more or less intensity in the adjoining integuments, which present the characteristic signs of the former *degrees*, namely, erythema, swelling, phlyctenæ.

The augmented thickness of the eschar here furnishes the means of differential diagnosis.

Towards the fourth day, as formerly indicated, the pain is revived in the point of injury; pungent and burning over an extent proportional to the size of the slough. At this period, a reddish inflammatory zone encircles the eschar. The pain increases progressively with the inflammation up to the eighth or ninth day, when separation begins to be effected: it then abates. While this process is being established, the inflammation becomes concentrated, subsiding in the parts remote from the scene of action. More or less tumefaction is manifested also on the commencement of disunion between the dead and living textures, first indicated by a line of demarcation or furrow in the circumference, which daily approaches the centre until the eschar is completely undermined and insulated. The concomitant suppuration becomes gradually more and more abundant towards the end of the term; and brings away along with it shreds of gangrenous cellular tissue, which exhale a most offensive odour. The time of the fall of the eschar depends on its volume and extent, on the age and temperament of the subject, and usually occurs between the fifteenth and twentieth days. Cicatrization is accomplished in one of two ways; either by re-union of the surfaces of the sore, or by regeneration of the cutaneous structure.

The first mode of healing is rare, since it requires for its completion a more exact coaptation of the sides of the sore, than is usually met with in burns. The following are the steps of the process. So soon as the blood ceases to flow and the pain is allayed, plastic lymph exudes along the raw surfaces and agglutinates them. By and by numerous new vessels spring from the capillaries, penetrate on all sides the molecular substance of this effused product, and form a tortuous vascular net-work, which progressively passes through the various grades of organic evolution, acquiring sensibility and firmness, so that it is no longer possible to effect disunion without producing pain and hæmorrhage. The new substance remains for a time more compact and vascular than the contiguous parts, but at length becomes so intimately blended with them, as to leave no appreciable trace of its existence.

Where the sore heals by granulation, a layer of plastic lymph effused without the vessels, resembling false-membrane, is deposited on the surface; at first inorganic, but promptly becoming vitalized. Minute conical granulations spring up, the result of cellular development. These vascular contractile vegetations secrete pus; are rapidly destroyed by ulcerative absorption, and as rapidly reproduced. They subsequently become obliterated and transformed into a corrugated tissue, somewhat analogous to true skin; for no sooner does the cicatrizing pellicle find a point of support on the vascular granules, than it extends from one edge to the other to form this condensed and contracted membrane. Meanwhile the secretion of pus, at first copious, becomes less and less, and is at length suppressed altogether. Thus is generated a new cutaneous investment, resembling although not identical with the original structure. The *derma* is more dense, less areolar, less supple, less vascular, less papillary than natural. The epiderm is restored with its several layers, a fact ascertained by dissection of negro subjects. But, as Dr. Donnellan justly observes, the shade of colour is altered, so that even among fair people the cicatrices may be always distinguished by their white, pearly, dry, smooth, and glistening surface; the organs of exhalation, namely the sudoriferous or hydropherous canals, the organs of inhalation, and the secreting apparatus of the pigment, being imperfectly developed or absent.

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[1] See an elaborate analysis of his memoir on the structure and function of the skin, in the Dublin Journal of Medical and Chemical Science for September, 1835.

The author just mentioned, states, that besides these anatomical differences, the *accidental* integument is more liable to ulceration than its predecessor. It is prone to injury from the slightest cause, and is the seat of various pathological changes. On this account the patient is liable to continual relapses during the progress of cure. His sufferings are often prolonged by the sudden rupture of an extent of cicatrix, the formation of which had occupied several months. It is true, indeed, these excoriations are only superficial, the basis is not destroyed; and it is remarkable how soon a new protecting envelope is supplied. This facility of renewal is an attribute of that species of vegetative life, which M. Breschet[1] has shown to be inherent in the epidermis. Numerous instances are on record where the cicatrix has been absorbed at periodical intervals; coinciding, for example, with the sexual evacuation, and, by discharging blood, acting vicariously for the uterus. Even during the suppurative stage, an evident change has been observed at the menstrual epoch, the surface of the sore becoming turgid, and emitting puro-sanguineous fluid.

Some deformity is the necessary sequence of this degree of burn. The bridles of skin and the depressions along the scar, are more irregular and profound than after the third degree. And even under the most favourable circumstances, the recent integument never has an extent equivalent to the original skin. The part is stiff, and constrained in its movements.

The *fifth degree* differs from the foregoing, only in so far as a greater number of parts are involved; the lesion extending to aponeuroses, muscles, tendons, vessels, nerves, as far as the bone. The symptoms referrible to sensibility and motion, vary according to the parts implicated; hence the slight, or lancinating, or neuralgic pain; the numbness or insensibility of the extremities; the partial or total abolition of motive power. The burnt surface is hard and stiff like a piece of shell: on attempting to move it, we find it firmly adherent to the parts beneath. Violent constitutional disturbance is developed about the fourth or fifth day. The time at which the eschar comes away, varies according to the degree of vitality wherewith the respective tissues are severally endued. In the first place, towards the fifteenth day, the skin and cellular tissue are thrown off; next the vessels and nerves; lastly, after a lapse of weeks, or even months, the exfoliation of tendons and bone. The consecutive ulcer is deep and extensive.

Cicatrization at length takes place. It is always attended with inconveniences more or less grave. These have been classed under four different heads; namely, adhesions, deformities, mutilations, and functional lesions.

By *adhesions* is meant vicious union of the cicatrix with neighbouring parts, impeding motion. This is best understood from knowing the part at the expense of which they are formed. Thus, for instance, suppose the elements of a cicatrix furnished by an aponeurosis, a tendon, or bone, then the new cellular tissue being neither extensile nor elastic, prevents the recent integument from moving on the parts beneath.

The *deformities*, or changes of relations between parts, are induced by the contraction of a cicatrix, by the coalition of contiguous surfaces, by the lesion of tendons or destruction of muscles, and finally, by the cessation of muscular antagonism from division of a nerve.

The *mutilations* are either primary or secondary. The former result from the immediate destruction of every thing intermediate between the skin and bone, forming the pathognomonic sign of the *fifth degree;* the latter, from the violence of inflammatory reaction, or the supervention of gangrene.

The *functional lesions* are referrible to the changes above enumerated. Thus faulty adhesions will circumscribe the range of voluntary motion; deformity will induce a variety of affections; and mutilation determine the privation of unctions, for the exercise of which the lost organ was destined. (*Donnellan.*)

It is by no means easy to distinguish immediately after the infliction of the injury, between the present and former degrees; because it is only by successive stages that the characteristic signs are developed. The depth and solidity of the eschar, together with the interruption in the functions of sensation and voluntary motion, are the principal diagnostic marks. We would briefly notice the fact, that in every case of burn attended with eschar, the work of *inflammatory elimination*, as Dupuytren called it, does not attain its acme before the ninth day, after which period it begins to flag. The declension has been termed the *stadium decrementi.* With each succeeding day from that date, the limits of the mischief become manifest, for reasons formerly assigned. The popular belief, that burns advance progressively for nine days, is founded on misinterpretation of the above circumstance.

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[1] Op. cit.

As has been already said, it is in many cases difficult, nay even impossible, to define with accuracy *à priori*, the amount of lesion. Because, while the parts on which the caloric has expended its force have undergone thorough disorganization, the adjacent textures have suffered more or less ; and, though not altogether deprived of vitality, have nevertheless been rendered incapable of supporting the subsequent inflammatory action. They are thus compelled to participate sooner or later in the process of destruction. Hence, it is of the last importance in medico-legal inquiries concerning burns, from the *third degree* and upwards, to defer giving any decided opinion until such time as the eschar shall have been sufficiently detached, for ascertaining accurately the full extent of injury sustained.

Sixth degree. The complete charring, incineration, or conversion into a carbonaceous mass of an entire extremity of the human body, is in itself sufficiently characteristic of this grade. It may, however, be added, that the loss of weight, the shrivelling, the fragility, and the sonorousness when struck, will remove all uncertainty as to the amount of lesion. The eschar is more or less perpendicular to the axis of the burnt part, and includes all the organic components. Upon its separation, a sore similar to that which results from amputation is left behind.

To this degree, M. Dupuytren referred the combustion named spontaneous, " if," says he, " death may be considered in the light of a malady ;" a doctrine hardly admissible, as it involves a confusion in thought, and a solecism in language.

While the above distinguished surgeon carried further than any preceding writer the subdivision of the shades of lesion in question, he did not overlook the practical difficulties thence arising. On the contrary, he guards us against expecting to find each grade accurately defined, or presenting uniformly the series of phenomena just detailed. Indeed, if we except the erythematous degree, it is a rare thing to meet with any one of the others wholly by itself. They are commonly combined, exhibiting every shade of complication. Thus, commencing with the most profound eschar penetrating to the very bone, and invading the entire thickness of a member, as we approach the surface and examine the confines, we see it merging by hardly appreciable gradations, till nothing more than the rete mucosum or epidermis is involved. The principal eschar is again surrounded by smaller ones ; these in their turn bordered with a zone of erythema, studded with phlyctenæ.

General Effects.—Each of the successive degrees that has occupied us, according to its extent or situation, may either constitute a purely local affection, or determine constitutional disturbance, which may bring the life of the patient more or less into jeopardy. These general effects are either primary or secondary, and have with much propriety been referred to three principal periods in the course of the affection :—

1. Those appertaining to the first stage, contemporary with the date of the injury, or speedily consecutive thereto, are the result of shocks imparted to the nervous system, manifested in sympathetic depression of the general system, or diminution or suppression of the functions of the skin from destruction of a large extent of surface.

2. Those belonging to the second stage, consist of the sympathetic internal inflammation consequent upon the general reaction, and are generally developed about the third or fourth day.

3. The third series comprises the effects of suppuration, exhaustion, and gangrene, which are felt at a more advanced period. The powers of the constitution being exhausted by the efforts it has made, are no longer equal to the accomplishment of a protracted cure.

Where the lesion is very severe, and occupies a large extent of surface, the suddenness and intensity of the pain may produce upon the sensorial and nervous centres an impression so profound, as instantaneously to overpower animal and organic life. The irritability of the whole nervous system is at once annihilated, and immediate death is the result. When such is the case, it would appear as if the blood, under the influence of the excessive stimulation of the heart and arteries, had endeavoured to force its way through every pore upon the internal surfaces. This may serve to illustrate, in a remarkable degree, the mode in which nature operates, when internal parts, in a state of inflammation, are relieved by vesicatories, and other means of counter-irritation. The following are the appearances detected on cadaveric inspection, according to Dupuytren. The mucous membrane of the alimentary canal exhibits, in the great proportion of subjects dead in the midst of flames, or soon after being withdrawn, red patches, of a greater or less extent, and of a very vivid hue ; blood has been seen exhaled into the cavity of the stomach, as well as into that of the intestines, and mixed with the mucus, and other fluid contents of these viscera. The brain is found gorged with blood ; the serosity of the ventricles acquires a reddish tint; the same is frequently met with in a fluid lubricating the cavities of the pleura, the pericardium, and the peritoneum. These contain, in like manner, sanguinolent mucus; their lining membrane being dotted with red points, exhibit considerable vascular injection.

In the case of a girl who died of tetanic convulsion on the nineteenth day from a severe burn of the abdomen and lower extremities, cadaveric inspection revealed the phenomena of high irritation of the alimentary canal, the stomach perforated to the extent of a crown-piece, and the aorta inflamed [1].

When the shock has been less powerful, we find various symptoms of nervous exhaustion and diminished vitality induced. There may be total or partial abolition of consciousness, from which, if the sufferer be roused, he evinces languor and apathy, and replies slowly and imperfectly to questions that are put to him. The sensibility is impaired; the pupils are dilated, as if labouring under compression of the brain; the heart is fluttering; the pulse is frequent and feeble, often scarcely to be felt at the wrist. The surface of the body, in the parts unscathed by the fire, is cold and pallid, sometimes bedewed with a clammy sweat. The respiration is slow and difficult: this difficulty of breathing is greater than what is observed after other accidents, and is to be ascribed to the great sympathy subsisting between the skin and the lungs; the interrupted function of the one rendering imperfect the nervous communication to the other. There is great prostration of the muscular power, the limbs remain immovable and abandoned to their own weight, agitated from time to time by convulsive shudders, or spasmodic twitchings. Low muttering delirium is not unfrequent. This state of collapse may abide for hours, and then passes off, or it may terminate in coma, convulsions, and death. The recovery from the above condition is announced by signs of reaction; the development of which is due, in a great measure, to the intensity of pain.

Such are the appalling consequences of severe scorching of the living tissues, induced by pain and nervous shock. Apart from these, there remains another mode in which these accidents may prove alike speedily mortal, where no disorganization of the textures has taken place. That is, in burns and scalds of the first or second degrees, in which more than two-thirds of the whole cutaneous surface is affected. These slighter forms of lesion, when not extensive, and where the patient is endowed with a moderate share of sensibility, may be regarded as a purely local affection, and not likely to be attended with any general disturbance. But when the injury has attained, or passed beyond the above assigned limits, the most disastrous termination may be anticipated. Here the fatal event is brought about, neither by the amount of pain produced, nor by the degree of nervous irritation, but by the perturbed equilibrium of the animal œconomy, dependent on the sudden suspension of the function of the skin. Rust has designated this as death beginning at the skin—cutaneous asphyxia. In such cases, the pulse, at first rapid and contracted, soon diminishes in frequency, becoming slow and intermittent, indicating a distinct obstruction to the circulating current. Depletion affords only transient relief; and the flow of black blood from the open vein stops long ere the desired quantity be withdrawn; or, as frequently occurs, no blood whatever can be obtained, though several veins have been punctured. The breathing becomes laborious and oppressed; dyspnœa, together with intense feeling of anxiety, precede dissolution. The same train of phenomena has been observed to supervene on other affections of the skin, when its functions, correlative to the organs of circulation and respiration, have been suddenly interrupted. M. Marjolin has related an instance of this description in his lectures. A negro, employed at the Bains Vigier, in Paris, wishing on one occasion to warm his limbs, benumbed by cold, during a rigorous winter, immersed himself in a bath heated to a high temperature. It was not long before he began to complain of a general feeling of uneasiness, together with lively pain of the skin. He was immediately withdrawn, and carried to the Hôtel Dieu, where he expired, in the space of thirty-six hours, from the effect of his imprudence.

For the most part, in burns of the two first degrees, the pain immediately consecutive to the action of the caloric, continues as long as the cutaneous irritation which gave rise to it; becomes mitigated in proportion as that irritation diminishes, and at length subsides. On the other hand, when the internal layer of the epidermis, or rete mucosum, and the papillary surface of the integument, have been disorganized, the pain abates on the formation of the eschar, the sensibility of the subjacent textures being apparently deadened. The patient is then tranquil, and free from suffering. But this deceitful calm is of brief duration. Towards the fourth day nature begins the process of separation of the dead parts. This is accomplished by the living parts taking on the process of ulceration, and becoming detached from the eschar. The ulceration begins at the margin of the slough, and gradually proceeds to the centre, as formerly stated, undermining progressively until the inanimate portion is entirely severed from the living tissues. At this period the pain recurs, as formerly stated, modified in intensity, according to the firmness of structure, and sensibility of the part. The system having fairly recovered from the effects of collapse, reaction takes place as in an ague after a cold fit. The pulse becomes frequent, but variable in strength and frequency, the skin is hot, the tongue white, the face flushed; pain is complained of in the head, the chest, or the abdomen; the respiration is embarrassed; cough may be present, and, perhaps, pain on deep inspiration. As the febrile symptoms proceed, there is restlessness, insomnia, red and dry condition of the tongue, sometimes nausea and vomiting, attended with great nervous excitement.

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[1] Darchis, Essai sur la Brûlure. Paris, 1828.

This sympathetic irritation of the viscera is often sufficiently intense to occasion death. Thus many patients, who have survived the primary effects, die between the fourth and ninth day, from the violence of inflammatory reaction. Dependent on the excessive stimulation of the arterial system, gangrene is a result much to be dreaded, as tending speedily to terminate existence. In some rare instances, affections of a purely spasmodic nature are induced during this interval, without any notable precursory inflammatory reaction. Thus patients are carried off by tetanus and convulsions. I happened to be present at the post-mortem examination of a girl, a patient in St. George's Hospital, who was attacked with convulsions, and died in a few hours, on the ninth day from having her arms scalded. A parallel case is related by Dr. Macfarlane. In habitual drunkards delirium tremens is by no means rare. In delicate females, during the period of utero-gestation, premature labour is frequently the consequence. About the fifth or sixth day apoplectic seizures sometimes occur; these, Dupuytren ascribes to individual peculiarities.

Dr. Cumin, of Glasgow, has recorded several cases of burn, in which death took place, in consequence of phlegmasiæ, developed at the period in question. From a survey of the pathological appearances, he is led to conclude that internal inflammation consequent on injury from burn may arise in the head, in the chest, and in the abdomen; and that the tendency of the inflammatory action is to produce effusion within the cavities of serous membranes. He admits that the mucous membrane participates in the inflammation, but not to the extent that some French pathologists have asserted. Dr. Cumin's deductions, though apparently confirmed by the cases detailed in his paper, are somewhat at variance with the experience of Dupuytren, who mentions his having found manifest signs of acute irritation in the stomach and intestinal canal. The other viscera, as the brain and lungs, were less constantly, and less profoundly altered, although traces of sanguineous congestion and inflammatory changes were frequently perceived.

Dr. Cumin has moreover shown, that though distant internal parts sympathize with burned surfaces, yet those immediately subjacent suffer most remarkably.

The pain occasioned by the secondary inflammation of subjacent tissues to those which the fire has injured, is neither so acute nor so irritating after burns of the fourth, fifth, and sixth degrees, as after those of the third. This phenomenon Bégin conceives to be due to the circumstance, that the cellular tissue, and adjoining soft parts, the seat of the phlegmasia, are less sensitive, and more dilatable than the cutis.

Should the patient have withstood the first impression of the burn, and the subsequent inflammatory reaction, great caution must be exercised in pronouncing a decided prognosis in favour of recovery. For even after the subsidence of fever, when he is apparently going on well, his appetite good, his pulse but little above the standard of health, extensive experience has shown that his convalescence is still beset with many dangers, and that these favourable appearances are but too often fallacious. If the lesion be profound, and some of the great vessels implicated in its course, the fall of the eschar must be contemplated with the utmost anxiety. For should it remove with it a portion of the vascular tunics, it will necessarily leave a gaping orifice, capable of furnishing a hæmorrhage sufficiently copious to compromise life. I had an opportunity of witnessing an instance of this kind in a patient in the Glasgow Infirmary, in whom the femoral artery was ruptured. Again, the exposed vessels, though sound, may become inflamed, either from the irritation produced by the burn, the contact of air, or foreign matter, and so give rise to accidents of the most grave description. It is a remarkable circumstance, that people go on well till the separation of the slough, then rapidly die, without our being able to assign any reason for their death.

When the sloughs have been thrown off, and suppuration is advancing, the patient may die from inanition, or from purulent reabsorption. When the suppuration is excessive, unless the patient have strong bodily powers, he will sink under it in a few days. Nature goes on well to a certain point; but when a copious discharge is set up, more than the constitution can bear, recovery is hopeless. The stomach begins to flag, it becomes squeamish, rejects the food. The pulse becomes frequent, and progressively weaker, till it cannot be traced. Hectic and marasmus close the scene. These alterations for the worse sometimes follow each other in rapid succession. Again, the continued constitutional excitement kept up during this period, may call into activity latent morbid predisposition. Thus tubercles, whose existence had been previously unsuspected, are developed in an acute manner, pass rapidly into the stage of suppuration, and carry off the patient. Or he may bear up for a longer time, and then fall a victim to insidious chronic disease of the alimentary mucous membrane, as pathological anatomy has abundantly proved.

Where the pus becomes altered in its qualities, is absorbed and conveyed into the course of the circulation, it gives rise to a train of symptoms of a very grave description. These may be ascribed to the consequent vitiation of the vital fluid, or the obstruction which the pus creates in the circulation of the pulmonary capillaries[1]. The effects thus produced are mostly of a nervous and asthenic type ; as delirium, convulsions, vomiting, to which are superadded, profuse perspiration, and colliquative diarrhœa. The pulse is tremulous, small, and intermittent. The features are contracted, the countenance assumes a muddy hue, the teeth and lips become encrusted with sordes, and death supervenes, with all the signs of typhoid prostration. On subsequent examination, the blood is found to be fluid and black, and the animal tissues soft and flaccid.

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[1] Vignal, Op. cit.

Thus it has been shown, that the immediate pain, the secondary inflammation or irritation, the excessive and protracted discharge, and absorption of matter, are the circumstances which endanger life in cases of injury from burns and scalds. The first has been designated the period of irritation, the second of inflammation, the third of suppuration and inanition. Dupuytren has enumerated a fourth period, that of cicatrization. It is a phenomenon, not less remarkable than obscure, that patients die suddenly, and without any assignable cause, at the time when the sores are healed, or nearly healed. Cadaveric inspection has failed to elucidate this point. Delpech conceived that the fatal issue in these cases was attributable to a perturbation of the functions of the skin ; meaning, thereby, that a free discharge of matter from an ulcerated surface, vicarious to the cutaneous transpiration, having been suppressed by the formation of a new cutaneous tissue, incapable of executing the proper functions of the skin, the equilibrium between the external and internal tegumentary envelopes being interrupted, death was the result ; in other words, death beginning at the skin, induced paralysis of the heart, analogous to what has been already stated relative to the mortal consequences of extensive superficial scalds.

Prognosis.—To institute a prognosis in cases of burn, a variety of circumstances are to be taken into account ; on the one hand, the intensity and extent of the lesion, its seat, and the nature of the injured part ; on the other, the age, the constitution, and previous habits of life, of the subject.

In reference to the former, it may be observed, that the constitutional effects are not so much correlative to the depth of structure destroyed as to the extent of surface affected, while the amount of consecutive deformity and mutilation is directly proportional to the profundity to which the caloric has acted.

Burns of the second degree, occupying an area of two or three square feet, are fraught with imminent danger, and if one-half of the whole surface be affected, most commonly prove mortal. The precursors of death are increased pain, exacerbation of fever, and a violet tint of the surface.

Those of the third degree, where disorganization of part of the chorion, rete mucosum, and epidermis, has occurred to the extent of a square foot, may induce death in young children, aged persons, or individuals reduced by intemperance or previous disease. The life of adults is not seriously endangered, unless a fourth or fifth part of the surface of the body has been attacked. When that amount is involved, in addition to the accidents attendant on the preceding degree, such as the intensity of pain and violence of inflammatory re-action, those resulting from suppuration and exhaustion are superadded. If the patient recovers, there is no deformity left ; the skin not having been totally destroyed, the cicatrix forms without any retraction of the margin of the sore. But however complete that cicatrix may be, its texture never acquires the perfect organization of the primitive integument ; it is more sensitive to the air and clothing, and less apt to convey the impressions of touch. It is prone to irritation from the most trivial cause, as a slight indisposition.

Burns of the fourth, fifth, and sixth degrees, where more than a square foot is implicated, are attended with the utmost peril. Here the chief danger proceeds from the debilitating process of suppuration, and the evils to which that may give rise, ere reparation can be obtained, even if the patient has withstood the primary shock and subsequent inflammation. The breach of continuity, when the sore does not unite by the approximation of the sides, can only be filled up by the interposition of a cutis of new formation, of which the diameter is always less than that of the ulcer. Hence proceed depressed or contracted and irregular cicatrices, which adhere to subjacent parts and organs. The patient seldom recovers the perfect use of the injured part.

Burns and scalds of the thorax are dangerous from the likelihood of pleuritic inflammation, and its sequelæ. Those of the abdominal parietes are tedious in cicatrizing, because the muscles of that region are kept in constant action by cries, efforts to cough, movements of expiration, and expulsion of the fæces. Morever, violent peritonitis may be excited, and, during the period of utero-gestation, premature labour is to be dreaded [1]. Burns of the inguinal region predispose to hernia. Those occurring in the vicinity of an articulation are not unfrequently followed by ankylosis, from the habit the patient has of maintaining the limb in a state of flexure. I formerly alluded to the dangers from hemorrhage, when treating of the separation of the eschar. Dr. Donnellan represents a burn about the verge of the anus as a grave accident, because it is for the most part accompanied with obstinate constipation, produced mechanically, as in fissure of the anus, by the resistance caused by the pain to fæcal evacuation; when the constipation is succeeded by diarrhœa, the discharge so deteriorates the nature of the sore as to cause death. Dr. Donnellan observed an instance of this kind at the Hôtel Dieu of Paris [2]. Tetanus is most apt to follow upon burns of the hands and feet, owing unquestionably to the liberal distribution of nervous filaments to those parts.

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[1] See a case in Dr. Macfarlane's Clinical Reports, p. 252.

[2] Précis sur la Brûlure, p. 11.

The disposition of these ulcers to close by the approximation of the margins, and to form vicious adherences, is frequently so great as to baffle the most powerful mechanical contrivances. Thus, it is no uncommon thing to see the fingers thrown back upon the carpus, and confounded with it; the arm permanently fixed to the fore-arm; the foot distorted in various directions, constituting a misshapen mass, bound to the leg[1]. Rideau mentions that a man, who had a severe burn of the neck, kept the head fixed upon the chest till the sore was healed, by the advice of his neighbours; in consequence of which the chin remained ever afterwards attached to the breast. Sometimes the head has been retracted towards the shoulder, and the nape to the back.

As regards the seat of injury, severe burns and scalds of the head and face are perhaps the most dangerous, on account of their proximity to the brain, from the risk of meningeal inflammation. Burns in the orbital region are likewise serious accidents. Fabricius Hildanus[2] failed in attempting to restore vision to a man, in whom the cornea had been penetrated by a single grain of gunpowder. Those of the eyelids, though apparently slight, may be followed by ectropion, partial ankyloblepharon, and symblepharon[3].

With regard to the period of life, it may be affirmed that the two extremes run the greatest danger. Young children and infants, from their high nervous susceptibility, speedily fall victims to the constitutional irritation. Persons advanced in years, in whom the vital powers are waning, being unable to support the exhausting process of suppuration, commonly die. Should they outlive the accident, the sores are usually transformed into obstinate or intractable ulcers. It is a striking fact, however, that the old, the infirm, and the decrepit, not unfrequently surmount the danger, while persons in the vigour of manhood are borne down, simply because the former are less obnoxious to diarrhœa. The rapidity with which the most robust are reduced by purging is very remarkable.

Individuals endowed with a strong bodily frame, and a moderate share of sensibility, are in less danger than those of a nervous irritable temperament, of a scrofulous or scorbutic habit, or those whose constitution has been shattered by previous disease and debauchery. It is consistent with extensive experience that severe burns generally prove fatal in subjects addicted to the immoderate use of alcoholic liquors. Patients of a mild disposition, bearing submissively the pain of the injury, and maintaining always the position enjoined to them, however irksome that may be, have a better chance of recovery, and recover more speedily, than those of an irascible, restless temper, who cannot be kept quiet.

Treatment. The leading indications are, to calm the pain as promptly as possible; to prevent the accession of inflammation; to preserve contiguous parts from mortification; to promote the separation of dead parts; and to counteract deformity and disfiguration.

No subject in the wide range of surgical therapeutics has, perhaps, obtained more attention than that of ascertaining the best means of counteracting the effects of fire upon the human body. It would indeed be a fruitless task to endeavour to enumerate the multitude of nostrums and remedial agents that have been alternately cried up and abandoned. It is, therefore, my intention to detail succinctly those curative measures, which the ample experience of the most enlightened practitioners has shown to be judicious and effective in the treatment of a lesion, frequent in occurrence, and often fraught with danger.

The first thing that requires to be done is to remove the clothes from the injured parts; and this with the more urgency if it be a scald, when the liquid has lodged between the skin and the garments, or if the injury has been caused by the clothes catching fire. In either case the utmost nicety and precaution must be taken so as not to remove the epidermis, which is, under such circumstances, generally blistered. Otherwise intense pain, capable of occasioning the most serious effects, may be the consequence. If the legs be severely burnt, the stockings may be left on, as they serve the purpose of dressings, when soaked with the remedy. It should always be borne in mind, that a portion only of the injured parts is to be exposed at a time.

We must adapt our curative measures according to the degree of injury, after its extent has been ascertained. It is generally admitted that slightly stimulating applications after the great stimulus of fire, are attended with the most beneficial results; therefore, in superficial burns or scalds, the best application that can be made is cloths dipped in tepid vinegar, which was Hunter's practice, or a mixture of vinegar and spirits, also tepid. The great advantage attending such remedies is, that they are always at hand. Pencilling over the part with lunar caustic has been recommended; it relieves pain, and prevents vesication. Liquid ammonia is used in some parts of France, and seems to act in the same way. Refrigerant saline solutions, ethereous and alcoholic lotions, which cool the surface by evaporation, are to be deprecated. Yet Dr. Thomson, of Edinburgh, and Professor Richerand, of Paris, concur in recommending the immersion of the body in cold water, as a means of producing speedy resolution in cases of very extensive superficial burns. The ensuing constriction of the capillaries prevents or moderates inflammation, whilst the sedative property of the remedy assuages pain, and impedes the sympathetic effects.

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[1] Bégin, Art. Cit.

[2] Lib. 4, de Combustionibus.

[3] Jüngken, Lehre von den Augenkrankheiten.

Thus the burn is localized, and no further treatment required. Great circumspection must be exercised, however, as to the application of cold, not merely because vesications take place more extensively on its employment, but because, if a large surface has its temperature suddenly lowered, that augments the tendency to collapse, and likewise the difficulty of breathing, and in the instance of the abdomen may give rise to dangerous disorders of the bowels.

As a general rule, the employment of oily and unctuous substances ought to be abandoned; they interrupt the local cutaneous transpiration, and favour the eruption of blisters.

If the burn be extensive, or if vesication be present, among all the means that have been proposed, there is none better suited for assuaging at once the pain and tranquillizing the patient, than a covering of carded cotton. It seems to act by maintaining an equable warmth, and excluding the impression of the external air. Cotton wool has been in great repute among the surgeons of North America, as a cure for burns. The discovery of its efficacy, according to a tradition, was purely accidental. The infant of a negress having had the whole surface of the body burnt, was uttering the most piteous cries; the mother, terrified, and not knowing how to act, placed it in the midst of a heap of cotton, while she hastened to procure assistance. On her return she found the little sufferer calm and free from pain: guided by this unexpected success, she wrapped him up in the cotton, and he rapidly recovered. Latterly the cotton has been much used in Scotland. To Dr. Anderson, of Glasgow, we are indebted for many valuable observations respecting its employment.

The most remarkable and immediate effect of the application of a fleece of cotton, when laid upon a burned or scalded surface, is the prompt cessation of the pain and irritation. In superficial cases, by diminishing the inflammatory phenomena, it accelerates the cure; when the cutis is exposed or destroyed to a greater or less extent, the cotton forms with the liquid exudation a sort of envelope, which protects the denuded surface and favours the formation of a new epidermis; in the most severe cases, where the ravages produced by the combustion leave no hope of the patient's recovery, its utility is still great, for it occasions much alleviation, nay sometimes the complete subsidence of pain. Several patients who had been previously treated by other methods, experienced superior benefit by the use of this agent. A remarkable instance in corroboration has been related by Dr. Anderson. A young girl had both legs burned to the same extent; one was dressed with raw cotton, the other with simple cerate; this last remained for a long time inflamed and painful; the sores were not cicatrized before three months; while the leg dressed with cotton was found to be quite healed when the latter was removed in three weeks' time after its application, and had only been the seat of slight pain.

In France its advantages have been realized by M. Larrey, and several of his professional brethren.

The cotton is to be applied in thin recently carded fleeces. When vesicles or bullæ are present, more or less considerable, Dr. Anderson directs that the serosity be evacuated, and the part bathed with tepid water, before the cotton is laid on. The sores are then to be covered with successive strata of carded cotton, so as to preclude all compression and movement; in some cases, a roller is necessary to maintain the dressing. When the skin is deeply burnt, he prefers a lotion of spirit of lavender, or turpentine.

If the suppuration is so abundant, in one or more points, as to exude from the layer above, or if it exhales a fetid odour, offensive to the patient and his attendants, the moistened cotton is to be replaced with fresh fleeces. This must be performed with the utmost promptitude, so as to leave the inflamed surface exposed as short as possible to the air. But, as it is always important to keep the patient in a state of most perfect repose and quietude for some time, the dressings should be let alone as long as is deemed right, notwithstanding the disagreeable smell[1].

A plan similar to the above consists in applying to burns the silky pappus surrounding the seeds of several varieties of typha, cats-tail, or reed mace. The first notice of this plant as a topical dressing in burns is to be found in Dioscorides, who advises its application, mixed with axunge[2]. For several years the down of the reed mace had been employed as a remedy by the inhabitants of a village situated in the department of the Aube in France, and M. Jules Cloquet has the merit of directing attention to it by a series of successful experiments he instituted at the Hôpital St. Antoine in Paris. This mode, like that recommended by Dr. Anderson, is most advantageous, when the burn has pervaded the whole thickness of the skin, or even penetrated to the subcutaneous layer. The varieties of the plant best suited for the purpose are, the Typha latifolia; T. media; T. angustifolia. Before using it, the grains are to be separated from each other, to be well shaken, so as to develop the pappus, and yield a down as light as possible. The burned part is to be exactly covered with the down, until the process of cicatrization is completed, when the dressing comes away spontaneously. The typha, from its silky nature, acts as a singularly mild substance, no wise susceptible of creating irritation or giving rise to unpleasant traction. The layer, more immediately in contact with the denuded surface, absorbs the secreted fluids, forms with these a natural plaister, and remains connected with them till healed; while the external one, impermeable to the air, forms a sort of close felt, remarkable for its velvety softness; the effects of which are principally to protect the sore against the irritant action of the atmosphere, and facilitate by this means the formation of a less irregular eschar. As this plant has not the inconvenience of becoming dry on the outside, it does not drag upon the still tender tissue of the cicatrix, and force it to assume a vicious direction.

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[1] Glasgow Medical Journal, May 1828.

[2] Lib. 3. cap. 133. cit. in Dict. de Médecine.

From the above account, taken from Vignal[1], it is plain that the typha acts exactly as the cotton. But the latter, from the readiness with which it can be always procured in this country, will necessarily have the preference.

An inconvenience connected with cotton dressing is, that vermin are apt to nestle in it, and annoy the patients; and in some cases it has been known to aggravate the pain and constitutional disturbance[2].

In the same class with the methods just described for excluding the contact of the external air, may be ranked the dusting the part over with flour, or other desiccative powders. Flour, however, is liable to the objection, that if there be a discharge of matter, it forms a poultice or paste, that may become rancid, irritant, and very offensive. The combination of oxide of zinc with chalk is much superior.

To arrest the development of inflammation, and the formation of phlyctenæ, some of the old surgical writers advise holding the burnt part to the fire. Without denying the efficacy of such a proceeding, although it be difficult to account for it, unless we assume that *similia similibus curantur*, such a practice can only be resorted to, in the most trivial accidents of this sort, from the pain with which it is fraught. A more rational and not less efficacious means has been introduced by M. Bretonneau, of Tours. It consists in circular compression exercised upon the injured part by bandages, either dry or moistened with some discutient or narcotic solution. To obtain the desired good effects, it is proper, when vesicles are present, to give issue to the fluid contents by one or more punctures; after which the pressure not only opposes the exhalation of serosity, but preserves the epidermis upon the rete mucosum, which is thus protected from the air and external agents. On removing the dressing, we find the epidermis dried up, and ready to peel off. If, on the other hand, the part be denuded, then is it in the first instance to be covered with oiled-silk, cut so as to prevent the slightest fold; the skin, under the compression, recovers without passing to the state of suppuration.

M. Velpeau[3] is also a strong advocate for compression in cases of injury from burn. He has come to the conclusion that it rapidly assuages the pain, and prevents or dissipates the erysipelas, which is a frequent concomitant. Inflammation is also either prevented, or its progress arrested when developed. M. Velpeau substitutes for the bandages strips of adhesive plaister. These are to be applied equably over all the burned surface, in order that there may be no strangulation of any one portion. They must be applied so as not to allow of their yielding. For this end it is directed that each strap shall make a turn and a half round the limb. Where the region to which they are applied is unequal, the hollows are to be filled up with cotton or charpie. Their direction is to be modified according to the form of the part. Thus, on the leg, which forms a cone, they are to be disposed in a spiral, commencing from below upwards, each circle overlapping the one above to secure uniform compression. The frequency of dressing will depend on the amount of surface denuded, and the consecutive suppuration. If the discharge be copious, the plaisters ought to be renewed every two days; if moderate, once in ten or fifteen days will suffice. It is expedient to surround the part with carded cotton, where there is much matter secreted. Great caution is to be had in removing the straps, to prevent injury of the new skin. Hence, in dividing them with the scissors, we must begin from below. Their use is contra-indicated in persons whose skin is delicate, and prone to erysipelas. In such cases, probably soap plaister spread on silk might answer, as offering a very mild adhesive application, suggested to me by Mr. Howell, of Wandsworth. M. Velpeau seems to think that much of the virtue resides in the emplastic composition.

Notwithstanding the advantage presented by compression, it is obvious that it is available only in certain cases. Thus, in burns of the head or trunk, it is quite inadmissible, and its employment, even on the extremities, requires great care. A bandage or strap ill-applied, may occasion strangulation, and the most dangerous consequences.

Resolution has been sometimes accomplished by abstraction of blood. Boerhaave and Van-Swieten have recommended, in the first instance, copious depletion. It is recorded of the former, that on one occasion, having had his face and arm scalded by the explosion of a Papin's digester, he was bled on the instant to fainting; this operation was repeated the following day, followed by a violent purgative; he was thus enabled to appear in public on the nineteenth day. M. Jules Cloquet has successfully adopted the practice in superficial burns, by the application of a number of leeches to the inflamed parts[1].

When there exists a solution of continuity without eschar, M. Lisfranc[2] recommends the solutions of chloride of soda or lime, as substances eminently endued with the property of producing a plastic exudation, which becomes organized like other false membranes.

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[1] Thèses de Paris.

[2] Dr. Macfarlane's Clinical Reports.

[3] Lancette Française, 1835.

[1] Vignal. Op. cit.

[2] Mém. de l'Académie, 1835.

This new tissue, usually developed from the circumference to the centre, closes in a short time the breach of continuity, as it were, by a flap of integument, transplanted by an operation of autoplasty from the neighbouring skin. He maintains that the cicatrix is more solid and permanent than that obtained by other methods. The chlorides are found to answer chiefly in the first and second degrees of burn, and are said to diminish inflammation and pain. The lotion is prepared by dissolving from four to six ounces of the chloride of lime in a pound of water. Its strength, however, ought to be such, that the heat and gentle pruritus experienced on its being applied, shall not last more than ten or fifteen minutes. If they exceed that period, the solution is to be diluted. The whole burned surface is to be covered with lint imbued with the solution and enclosed with a piece of lint spread with cerate and pierced with holes. It must be kept constantly moist. When there are vesicles they are to be opened and the epidermis removed. In other hands, however, it would appear that this method has not answered better than those commonly adopted. It appears to me that the cases in which these saline solutions are of utility, are those in which a fetid suppuration is emitted, whose bad qualities require to be corrected.

Creosote has been brought forward by its discoverer, Dr. Reichenbach, as a topical stimulant, whose action serves to accelerate greatly the cure of burns. It is employed in solution, and may be prepared by adding two parts of creosote to 100 parts of warm water. Compresses dipped in this are to be applied to the affected surfaces. This lotion, however, is nowise superior to those mentioned formerly.

Dupuytren's practice was to keep the burnt parts constantly covered with pledgets, moistened with a cold, aqueous solution of diacetate of lead. This lotion he believed to possess a two-fold virtue, being both astringent and sedative. It decolours the skin, counteracts the afflux of fluids, and alleviates pain.

The following plan has been recommended to prevent disfiguration from the scars caused by burns. Having opened the vesicles and allowed the contained fluid to escape, the part is directed to be touched with a stick of lunar caustic until dry, the epidermis being, as far as possible, saved from being detached. The pain soon subsides, and when the burn is inconsiderable, a single application is said to suffice. Should suppuration, however, ensue, the part must be again touched with the caustic. The crust that is formed covers the whole injured part and falls off in a few days, leaving a new, smooth, and even skin[1].

We are assured the same object can be effected by employing a somewhat different procedure. Cloths dipped in cold water are laid upon the burnt parts, and in the lapse of from twenty-four to forty-eight hours, when the vesicles formed have put on a gummy appearance, the elevated cuticle, forming their envelope, is to be removed with a pair of scissors; this prevents suppuration and consequent scarring[1].

In cases of injury from the deflagration of gunpowder, the grains should be carefully picked out with a needle from the rete mucosum in which they are lodged, to prevent inflammation, and subsequent disfigurement, especially if the face be the part concerned. A poultice is to be afterwards applied.

When vesications exist, we should not be in a hurry to open them. For this practice we have the high authority of Sir B. Brodie. The fluid becomes sometimes absorbed in a few days, by time new cuticle is generated, and when the dead cuticle peels off, the part is found restored to its normal condition. If, however, the vesicles are distended almost to bursting, so that great pressure is made on the cutis, when the pain and inflammation begin to diminish, puncturing with a needle at the most dependent part, and letting out a portion of the fluid, and repeating this from time to time, will be proper. It is not prudent to remove the epidermis which protects the nervous papillæ from the action of the air and the dressing. If some days have elapsed, after having given issue to the serosity contained in the phlyctenæ, the surface of the cutis is found secreting pus which escapes with difficulty, then the epidermis is to be stripped away, in order to favour the desiccation of the pus. Its removal at this time is not attended with pain.

In burns of the fourth and fifth degrees, as the sensibility of the injured parts is in a great measure impaired or annihilated, a more powerful stimulus is required than any of those hitherto noticed. Here terebinthinate applications will be found to be most efficacious, an excellent practice first introduced by Dr. Kentish. He directed the parts to be covered with rags dipped in oil of turpentine. When there is much depression of the powers of life, the turpentine ought to be applied tepid. This treatment is to be continued until the eschar begins to separate at the margins, and even longer.

Instead of the oil of turpentine, which from its fluidity is often unmanageable, the linimentum terebinthinæ, or Venice turpentine mixed with various proportions of cerate, may be employed, as recommended by Dr. Perry of Glasgow. I have seen the best effects produced by the last, of which the great advantage is, that it forms a plastic application, the strength of which can be regulated at discretion. Sir B. Brodie advises a liniment consisting of equal parts of green digestive[2] and oil of turpentine, which is the approved application at St. George's Hospital.

By these means the pain is relieved, and the contact of air excluded. In extensive burns, stimulant applications possess the further advantage, contrary to cold, of lessening the disposition to collapse. Here it must be especially minded that we are only to expose portions of the injured parts at a time.

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[1] Dr. Fricke in Casper's Wochenschrift, No. I. 1833.

[1] Dr. Tott in v. Grafe & L. Walthers, Journal der Chir. und Augenheilk. Bd. xix. H. 3. 850.

[2] Green digestive is prepared as follows:
R.—Ung. Elemi, lbiij. Ung. Sambuci, ℥ij.
Bals. Copaib. ℥iij. M.

Care is likewise to be taken, so to arrange the dressings that they will not fall off. A bandage may be put loosely over them, by which they are kept in their places three or four days if required. Should the dressings become deranged, they must be daily renewed.

In deep and extensive burns, it is always to be feared, that the inflammation may determine too powerful a re-action, and that the suppuration may exhaust the patient, by its abundance and duration. To prevent these dangerous sequelæ in a burn occupying the great part of one of the lower extremities, the thigh and the corresponding side of the trunk, M. Lacretelle, of the Val-de-Grâce at Paris, covered the principal portion of the burned surface with bladders filled with iced water, continuously for twelve or fifteen days. This ingenious plan was followed by complete success, and that almost unexpected, in a case where the disorganization was so extensive. It is well worthy of imitation. Attention must be had to renew uninterruptedly the iced water, as soon as its temperature rises, so that its action may be abiding, and that no re-action be developed in the parts to which it is applied. This is indispensable, for if the refrigeration be not sedulously maintained, this practice may prove injurious[1].

In cases of scald of the mucous membrane, as of the mouth or œsophagus, frequent ablution with some bland fluid must be employed. If the windpipe has suffered, and symptoms of inflammation manifest themselves, leeches and poultices ought to be applied to the throat, and frequently repeated doses of calomel exhibited, in order to arrest or subdue the exudation of lymph. When the symptoms are intense, the operation of laryngotomy or of tracheotomy may be performed, with the effect of preventing impending suffocation, and perhaps of saving life. Dr. M. Hall has reported four fatal cases of this kind, in the last of which temporary relief was procured by the operation of tracheotomy, although the child subsequently sank from exhaustion, caused by the irritation of the primary affection[2].

To promote the healing of the sore is the next point to be attended to. If it be a superficial suppurating surface, it may be simply covered with carded cotton, or dusted over with some absorbent powder, as equal parts of chalk with oxide of zinc. Sir B. Brodie recommends the powder to be put into a jelly-pot closed with a piece of gauze, as a ready means of dusting the pulverulent particles over the secreting surface. The powder absorbs the pus, forms a scab with it, under which the new cuticle is rapidly generated.

It has been observed, that where a very superficial degree of ulceration takes place, the nervous papillæ resist the ulcerative process more easily than the other structures, remain elevated above them, and stand forth prominently, giving an uneven appearance to the sore. Here various astringent and stimulant solutions will prove useful, as those of sulphate of zinc, sulphate of copper, and nitrate of silver. They must be changed from time to time, as they lose their effect after a few days. Cerates of different kinds have been recommended: Delpech used always the opiate cerate, but in many instances unctuous applications, from their proneness to rancidity, irritate and retard the healing process.

The separation of the slough is a natural process over which art has little control. Should it be an object of consequence, small poultices may be applied, or the water-dressing, that is, moistened lint covered with oiled-silk; and where much pain is complained of, the moistening fluid may be medicated with various anodyne substances. If the slough be extensive, not only will the poultice, from its weight, prove a source of distress in itself, but tend, as Dr. Macfarlane has pointed out[1] to induce exuberant and spongy granulations, and to establish that kind of unhealthy action, which forms so serious an obstacle to cicatrization. It is best to anoint merely the edges with simple cerate, or in some cases the entire eschar, to prevent its becoming hard and horny, as from its unyielding nature, it is apt to harass the patient on his shifting his position. When fluctuation is felt beneath the charred integument, it is proper to make an incision, in order to prevent the collection of pus. No traction must be ever attempted with a partially adherent eschar, but the floating margin may be cut away. When the discharge is very copious, and frequent change of dressing required, the tailed bandage of Scultetus is better than a common roller.

After the slough is entirely separated, the sore is to be treated on the general principles of surgery. The formation of the new skin proceeds from the edge of the sore, gradually covering it in towards the centre, till the whole is inclosed. Sometimes, however, it begins to form in patches near the centre, or at some distance from the margins, and then spreads over the surface, and that, independently of any portion of old integument that may have been left at the time of receiving the injury.

The cicatrix, closely analogous in its nature to the integuments destroyed, progressively spreads like a fine membrane over the granulations, having its growth from the surrounding uninjured skin; at first red and soft, but becoming by degrees white and thick, so as to form a complete envelope in the situation of the sore. When the surface of the latter is very great, it ought to be immediately covered with successive layers of fine fleece cotton, which must be retained in close apposition by means of a bandage. Thus the discharged fluid is absorbed, the tender granulations protected from injury, and cicatrization vastly promoted. In certain cases, when the pus is confined by the crust formed with the cotton, an aperture must be made into it with the scissors, the fluid evacuated, and fresh cotton made to supply its place. When the suppuration is excessive, saturnine lotions have been employed with advantage. I had occasion to witness their efficacy in the case of a patient of Dupuytren's, in the Hôtel Dieu at Paris. The greater part of the leg had been deeply burnt, exposing the bone, and over the extensive suppurating surface epithems, imbued with a solution of lead, were applied. The result was a gradual diminution of the discharge, cicatrization of the sore, and perfect restoration to health. The noxious effects to be apprehended from the absorption of lead into the system during its external employment, might advantageously, I think, be combated by the exhibition of sulphates of soda or potash or hydroguretted waters.

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[1] Dict. de Médecine.

[2] Dr. M. Hall's Edition of Underwood, p. 364. London, 1835.

[1] Clinical Reports.

When the ulcer is moderate in size, it may be rapidly healed by the water-dressing described above. If the surface is irritable and painful, solutions of the narcotic extracts, as conium, &c., or the liquor opii sedativus, diluted with water, may be advantageously applied. If the surface is pale and languid, tonics and stimulants, as the pulv. cinchonæ, the balsams, especially that of Peru, and Barbadoes naphtha will be proper. According to Dr. Donnellan, the ung. calamin. is an excellent application. The cerate ought to be thinly spread over a piece of lint, pierced with numerous holes: if too thickly applied portions will be left behind on the skin, which may irritate to such a degree as to occasion erysipelas[1]. When again the granulations are luxuriant and spongy, styptics and escharotics are indicated. From twenty to twenty-five grains of nitrate of silver, dissolved in an ounce of pure water, forms an excellent lotion. The addition of a little opium lessens the pain of the application, and does not interfere with its catheretic properties. A viscid sebaceous secretion is apt to form on the new skin in some cases; this ought always to be gently removed. When the margin is tender, it should be dressed with separate pieces of lint. The absolute importance of a light hand and assiduous attention are never to be forgotten. A careless and harsh removal of the dressing may be the means of tearing away the new skin, and undoing the work of many days. The exposure to the air also gives pain. The surface therefore should only be exposed by parts, and of course dressed by parts.

The excessive tendency to union of parts after burns, depends probably on a kind of abiding erethism in the sore. The granulatious become firm, solid, and of a bright red, and it appears that the more these characters are marked, the force with which parts are attracted to each other is proportionally greater. M. Bégin ingeniously suggests, that capillary bleeding from the surface of the sore, conjoined with the continued application of relaxing and narcotic epithems, as emollient poultices imbued with solution of opium, would prove efficacious against this excessive contractility by reducing it to the condition of an ordinary sore.

M. Velpeau mentions, that when the plan of strapping with diachylon plaister is adopted, the cicatrization does not proceed from the circumference to the centre, that is, by convergence, but simultaneously by layers over the whole surface of the sore; for which reason the extent of burns exerts no influence whatever on the duration of cure, a large burned surface requiring, according to him, no longer time for healing than a small one. The cicatrix is firm, solid, and without irregularity[1].

When the fingers or toes have been destroyed by fire, their separation is effected nearly as an ordinary eschar. It is sometimes necessary to divide with scissors the ligamentous cords or flaps of tendon by which they may still adhere[2].

In those cases where an extremity has been completely charred by combustion, amputation is the only resource. Is the operation to be retarded till such time as the first effects of the accident be past, or is it to be immediately performed? I am disposed to coincide with those surgeons who contend, that when no hope of saving the limb remains, and the limits of mortification are well-defined, amputation is indicated. In this way the patient escapes the sufferings from violent inflammation, which would be necessarily set up in the neighbouring sound parts, and also any sympathetic accidents which might ensue. If, however, there is any chance that the part may prove afterwards in some measure useful, and the patient is sufficiently robust to resist the various complicated evils to which he may be subjected, then let the operation be postponed.

Amputation is also demanded, when upon the separation of the eschar, a large articulation is opened, or when the sores are so extensive, deep, and irregular, that no reasonable hope of their cure can be entertained.

Constitutional treatment. — In superficial burns that occupy a limited extent, there is no necessity for exhibiting internal remedies, or changing in any respect the diet or regimen of the patient. But in cases of severe injury, it is far otherwise. If the patient be in a state of collapse, the pulse weak, and the extremities cold, stimulants are to be administered to rally the flagging powers, and restore the natural harmonies of the system. For this purpose, cordial drinks, wine, brandy, ammonia, ether, and camphor, may be exhibited together with gently stimulating enemas, and artificial warmth to the pit of the stomach; the extremities may be excited by sinapisms, and the uninjured portion of the surface by stimulant embrocations. No nourishment must be put into the stomach, as it will not bear it. The patient should trust for a time to his own solids. I have known the best effects wrought by the administration of brandy as recommended by Mr. Travers[1], given in gruel, in the proportion of one part of the former to two of the latter, in doses of a table spoonful or two, at short intervals, until a sufficient distinctness and fulness of the pulse is obtained, with a corresponding improvement of the complexion and superficial temperature. This treatment may be continued for days, occasionally intermitting it, and always gradually withdrawing it. The bowels are to be relieved by an enema, and if much stupor with previous costiveness exist, some gentle aperient, as a spoonful of castor oil, should be given. The stimulants may be gradually withdrawn on signs of approaching reaction; especially if the pulse become bounding, and the countenance flushed. The patient should be kept in a state of the utmost quietude, in a well-aired apartment. Where the pain is very great, opium, according to Dr. Dzondi, of Halle, is productive of the best effects. Mr. Travers, on the other hand, maintains that its use ought to be abandoned, as being in small doses inefficacious, in large, injurious. For my own part, I have never seen it do good. It is to the topical treatment we must look for relief.

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[1] Précis sur la Brûlure.

[1] Lib. cit.

[2] Dict. de Méd.

When the system cannot be roused by stimulants, it may be presumed that there exists an accumulation of blood in some internal organ, suspending and paralyzing the central organ of circulation, characterized by the sluggish and imperfect action of the heart, the feeble thready pulse, and the diminished temperature; for this, prompt abstraction of blood is the only remedy. In such cases a difference will be found between the cardiac and radial pulse.

Dr. Macfarlane states, that during the stage of collapse from a severe burn, after employing stimulants without effect for four hours, fourteen ounces of blood were taken away from the arm, after which a renewal of the stimuli proved more successful, for in less than an hour the heat was restored to the skin, and the pulse became full and bounding[2].

On the recovery from prostration again, if there be strong vascular reaction manifesting itself about the third or fourth day from the receipt of the injury, recourse must be had to general and local bloodletting. In a number of cases, the swelling of the surface in those parts where venesection is commonly performed may prevent the operation from being successful in abstracting blood, but there are few cases in which leeches or cupping will not afford a sufficient quantity. Nor does the removal of the cuticle, as Dr. Cummin has shown, prove any obstacle to the leeches taking. In some cases it will be prudent to resort to the employment of antiphlogistic measures, even before any febrile movement is manifested. I have seen much good obtained by frequently repeated small doses of sulphate of magnesia with tartar emetic. This combination acts gently on the bowels and the skin, tends to equalize the circulation and repress inordinate action. Where there is determination to the brain and the patient is vigorous, venesection must be performed: if coma be present, leeches and cold should be applied to the temples. The lancet, however, is not to be hastily or indiscriminately used: it is to be remembered that the patient has a long debilitating process to go through, we are therefore called upon to husband those powers on which existence depends. An excellent rule to observe in such cases, is neither to over stimulate on the one hand, nor to lower too much on the other. Excess on either side is alike prejudicial.

When suppuration is established, and the fever has ceased, or nearly so, the patient is to be supported with light, nutritious food. Too generous a diet is apt to retard the process of cicatrization, to render the granulations luxuriant, and predispose the patients to internal inflammation or apoplexy. An occasional purgative, as recommended by Dr. Kentish, is useful in favouring the formation of new skin. With this view calomel, with extract of colocynth, or calomel followed by a senna draught in the morning, may be exhibited occasionally.

Where the ulceration is extensive, and the suppuration excessive, when the subject is of a constitution naturally weak, or impaired by the inroads of previous disease, the bodily powers, being insufficient to weather the reparative process, sink under it. Probably the patient may be going on favourably for a time, after which he begins to loathe his food—vomiting and diarrhœa supervene, the pulse becomes quick and feeble. In such cases, when the symptoms are grave, medicine generally proves quite incapable of enabling the system to sustain the exhausting process going on, and the patient generally dies hectic and emaciated. The surgeon, however, may sometimes succeed in averting the impending evil. Let the patient have the lightest, and, at the same time, the most nourishing diet, given frequently and in small quantities, along with sulphate of quina and sesqui-carbonate of ammonia. Various astringent medicines may be administered to stop the diarrhœa. Dupuytren's favourite prescription was two grains of sulphate of zinc with one of the watery extract of opium every four hours. Opiate enemas and suppositories will be found valuable auxiliaries; and opium given by the mouth, in repeated small doses, will prove of great benefit when the patient can bear it. It allays irritation, and thus prevents the system from being worn out. Great attention must be paid to the comfort of the patient; hence if he suffers from moving about on a common bed, he should be laid on a water bed. Much good is often done in this way. Above all, the chamber should be freely ventilated, and his body and bed-clothes frequently changed.

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[1] Essay on Constitutional Irritation.

[2] Lib. cit.

While the cicatrix is forming, care must be taken that it be, as nearly as possible, of the same size as the original skin it is destined to replace. Burns of the first and second degrees seldom leave behind any trace of their existence, unless the error has been committed of removing too early the epidermis elevated by serum, the result of which may be troublesome ulceration. It is, however, quite different in respect to burns of the third, fourth, and fifth degrees. There the destroyed portions cannot be replaced; all we can attempt is to prevent the cicatrix from becoming adherent to the muscles, tendons, and other parts which have been exposed.

When the eyelids are burnt, it is not alone sufficient to obviate the cohesion of their free margins by means of tents, a suitable position must also be given to them to avoid a puckered scar, which might occasion a disagreeable dragging down, eversion of the lower lid on the cheek, or the inversion of the ciliæ towards the globe.

When we find the margin of a natural aperture deeply burned or scalded, its obliteration or contraction is to be counteracted by maintaining it dilated by means of tents, bougies, canulæ, &c. Tents of charpie are well suited for preventing coarctation of the vulva and anus, and metallic tubes or gum elastic catheters, for preserving the natural dimensions of the nostrils, and re-union of the alæ nasi with the septum; they possess the farther advantage of allowing the patient to breath freely. In burns of the fingers, toes, and other contiguous parts, care must be taken to keep them constantly apart, by extending them on pallett splints, fitted to the hand, in the case of the fingers, and by interposing lint spread with cerate between the toes.

When the burn has invaded the whole circumference of an articulation, we are to consider the position in which the member will be subsequently best apt to fulfil its functions; for the articulation of the knee, the leg is to be extended on the thigh; this position being most favourable for progression and standing; for that of the elbow the fore-arm is to be kept in extension. The cicatrix will form slowly in the sense of flexion, but the movements will be preserved. This should always be kept in mind, when it is likely the patient will be exposed to an abundant and tedious suppurative process.

For the tibio-tarsal articulation, the foot must be maintained in a position, neither extended nor flexed; the same rule applies to the radio-carpal joint. It is unnecessary to state that when the burn affects one side only of a joint, the limb ought to be kept to the opposite. If the neck be burnt all round, the head must be supported in its natural vertical direction; while, if the burn occupy but one side, the head should be kept slightly inclined to the opposite.

To obtain a smooth and equable cicatrix, the granulations, when too salient, are to be repressed with caustic; and, if necessary, with compression effected by a leaden plate.[1]

This latter practice however requires both skill and consideration, since undue pressure on the surface of the sore, whether caused by tight bandaging or improper position, is likely to induce a stasis of the blood in the capillaries of the part, the rupture of some of these vessels, and the extravasation of a greater or less quantity of sanguineous fluid. However small the hæmorrhage may be, it directly enfeebles the patient; the effused blood moreover irritates and inflames the sore, and if allowed to remain and get decomposed on the surface, tends to augment and vitiate its secretion.

Sometimes the ulcer is so narrow, that the contraction of the cicatrix takes place altogether from one side; in certain cases, by allowing the contraction to take place in one way, and by forcing it in another, a great deal of deformity may be prevented. Much discretion, however, is required; for if the surgeon attempts to overdo the thing, the ulcer does not heal at all. The point is, for him to see how much skin is left in other parts, and to manage accordingly; for should the new skin be strained, it is apt to crack and ulcerate afresh, and the patient has to undergo the whole process anew.

We are sometimes enabled, by means of oily embrocations, baths, douches, together with passive motion, to soften, extend, and even to obliterate the irregularities left by the cicatrization of burns. The surgical treatment of these, however, will be considered at full length in the article CICATRICE.

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[1] Dict. de Médecine, art. cit.

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(*Alexander Ure.*)

BURSÆ MUCOSÆ (deriv. βύρσα, a bag). These are small bags of fluid, which are found between the tendons in the neighbourhood of joints, between the tendons and the periosteum, and occasionally between the bellies of muscles. They possess a fibrous texture, with an internal, polished, and secreting surface. The fluid secreted into them is of the nature of, but not quite so viscid as the synovia. Anatomists generally regard this structure as identical with the serous membranes. Dr. Hodgkin speaks of the secreted fluid as the transition between serum and mucus; which view countenances the fact, that both the bursal and synovial membranes are interwoven in the sympathies of the serous and mucous surfaces. As instanced on the one hand, by the ready translation of gonorrhœal inflammation to the synovial membranes; and on the other, by the metastasis of rheumatic synovitis to the serous membranes of the chest.

The evident purpose of these sacs is, that of preventing the evil effects of friction under the movements of the tendons. The bursæ, strictly so called, are a normal structure, varying in size from a small pea to that of a hazel nut. But cysts of similar structure, and secreting a similar fluid, are capable of being *generated* on parts exposed to much pressure or friction. The bunion is an example of this *abnormal* structure, familiar to most persons. These are never so completely developed, or so perfect in their organization, as the natural bursæ; their texture is less firm, their secreting surface less smooth, and their secreted fluid less gelatinous. The bursæ undergo but little change under disease, beyond the ordinary effects of common inflammation. But when so attacked, much inconvenience, and often very tedious and protracted suffering, is felt not only in the parts themselves, but in those with which they are in immediate contact, and now and then, very serious constitutional disturbance attends on the local mischief.

The simplest, and most common form, in which inflammation of bursæ shows itself, is that of enlargement of the sac, in consequence of an excess of its secretion, by which it is distended to an unnatural size. The tumour thus formed, bears the name of ganglion; this being an enlargement of *one* bursa *only;* its extent is limited, and it presents itself as a definite and circumscribed swelling, seldom extending itself beyond the immediate bursa which is the seat of disease. There is, however, a form of bursal inflammation, more extended in its effects, which often becomes a grave and serious disease. This has its seat in the sheaths of the tendons; the aponeuroses, which bind down the tendons, are lined by a secreting surface similar to that of the bursæ, this becomes inflamed from the same causes, and the effects are but aggravated from the extent of surface, engaged in the inflammation.

The generated bursa, inasmuch as it is the product of irritation, under the continuance of the irritating cause which produced it, becomes often a very painful and troublesome complaint.

In order to treat of the disease of the bursæ, in such a way as shall best simplify the subject, I propose, first, to speak of the ganglion, then of the thecal inflammation, and lastly, of the bunion.

The ganglion is a round circumscribed encysted tumour, formed slowly by the enlargement of a single bursa mucosa; it may be found wherever a bursa is known to exist in the vicinity of the joints and tendinous sheaths; but the most common situation in which it is observed, is the neighbourhood of the wrist, on the back of the hand, or on the instep. It very frequently occurs also on the ligamentum patellæ, below the knee, and on the same tendinous expansion, as it passes over the patella itself; these parts being particularly subjected to the causes of irritation which usually produce the disease. Mr. Key has observed the ganglion on the tendon of the trochlearis muscle of the eye, and on the tendon of the gastrocnemius externus muscle. These tumours, for the most part, are found to exist singly, but frequently several are observed in the same individual. In by far the greatest number of cases the ganglion is a local affection, but sometimes it occurs as the result of rheumatic inflammation; when they exist in numbers, they may be generally referred to constitutional derangement.

Ganglions vary in size, which may, in some measure, be dependent on the natural size of the bursa. On the wrist they seldom exceed the size of a walnut; on the ligamentum patellæ I have seen one as large as an orange. The external character of ganglion varies much. At one time it is pellucid, compressible, and elastic; at another, it is firm and unyielding, giving a sensation, on examination, as if it contained a soft pulpy substance; these characters depending on the internal condition of the cyst. They are isolated from the parts on which they rest, and seldom, even in their advanced stages, contract adhesions of any strength with the neighbouring structures. They are slightly moveable, and so long as they remain small they are productive of but slight inconvenience.

The ganglion is generally produced by some locally irritating cause, such as friction, sudden exertion of the parts, and, perhaps, by stretching of the tendinous parts on which they are situated. The ganglion of the hand, more frequently than in any other class of persons, is met with in washerwomen, who use considerable exertion of their wrists in twisting, or what is called "wringing" the clothes. The ganglion patellæ is most common in housemaids, who are required to kneel at their work, and thereby subject the knee to frequent irritation.

It will be understood, that such causes as excite inflammation of the bursal cyst, whether local or constitutional, produce ganglion. By the French[1] a ganglion is considered to be a dropsical condition of the bursa, and so indeed it is, as much as hydrocele or pericardial effusion ; but the dropsy, or increased secretion, is only the result of inflammatory action. In this light it should be regarded and treated of, in order to arrive at any satisfactory notion of the affection. With a view to a practical description of the subject, I shall draw the attention of the reader to three conditions in which the ganglion presents itself ; and these distinct states are the effect of inflammation in its separate stages, begun and continued in the bursal sac.

The *first* effect of inflammation in the bursa, as in all other secreting organs, is an increase of its natural secretion, and consequent distension of the cyst. All we perceive is a soft, compressible, and elastic swelling, defined in its extent, the skin covering it being colourless, and moveable over the tumour ; if the skin is thin, the tumour is semitransparent, and may be slightly moved on the part on which it is situated. At this stage, at least, it will have formed no adhesions with other parts : and although the skin may not be painful, or discoloured, yet in the tumour itself a slight uneasiness is felt from distension, and the part beyond the tumour seems much weakened. If the ganglion has been suddenly produced, or if it has been induced by an attack of rheumatism, the tumour is exquisitely sensitive to the touch, and a slight blow accidentally given to the part is acutely felt. A ganglion cut into at this period or stage, shows no alteration of structure ; the abundant secretion is the only evidence of its deviation from the natural state.

The continuance of inflammation in the bursal membrane, and especially so, if it be aggravated by the perpetuation of the irritating cause which first set it up, leads necessarily on to the next stage.

In passing to the second stage, the ganglionic swelling becomes gradually more firm, until it is incompressibly hard and unyielding, or with considerable thickening of parts, a sensation is given to the hand of the surgeon, as if the tumour was partly solid, and partly fluid. Now even, the skin is in no degree discoloured, but it becomes adherent to the tumour, and the swelling itself becomes somewhat more adherent to the subjacent parts. In this stage, too, it has lost its semi-transparency.

On cutting into the ganglion at this stage, it is found that the cyst itself is much thickened, the cavity being filled with flakes of lymph, or a number of small granular bodies of various sizes, possessing the characters of the fibro-cartilage.

The next period observable in the progress of ganglion is that of *suppuration*, and subsequent ulceration. The arrival of this stage is for the most part long delayed ; the ganglion may remain passive for months and years, until, perhaps, fresh inflammation may be excited in the part, and then suddenly and rapidly the formation of pus takes place. The tumour, which until now has been colourless, assumes a fiery hue, its temperature is increased, severe pain attacks the part, and in a day or two suppuration is evident, the walls of the swelling, which had been thickened in the previous stage, become gradually thinner, and the tumour more swollen, ulceration soon causes the complete evacuation of the cyst, which at this time is found to contain pus mixed with the bursal fluid. During the progress of suppuration, which is generally of an unfavourable character, the febrile symptoms become alarmingly high, and a very considerable degree of constitutional irritation is set up, accompanied with such great disturbance of the functions of the brain, as to create alarm for the safety of the patient.

If the suppurative stage be slow, the constitutional symptoms are seldom severe, the only evil being an indolent wound from the indisposition of the sac to granulate. In some cases where suppuration occurs in the bursa of the patella, the sac gives way, and the pus collects in the cellular tissue around the joint. If the case be chronic, the knee has a very peculiar appearance, which has been mistaken for effusion within the synovial membrane. It is fortunate that we have a very simple means to save us from so gross an error, the patella being in the one case in the front of the tumour thrown forward by the effusion, in the other it is concealed by the external suppuration.

The treatment will vary with the situation of the bursa, the thickness of its parietes, and the consistence of its contents.

Treatment.—The cure of ganglion is readily effected in its first stage, whilst the parietes of the sac are thin and transparent. The common mode is to cause the bursting of the cyst by a smart but decided blow on the swelling. Although this is the most painful, and to a timid person the most objectionable mode, it is the most speedy and effectual. By this, the contents of the sac are extravasated, and inflammation sufficient is set up to cause adhesion of the cyst with the connecting parts ; and thus an entire obliteration of the cavity is obtained. In this mode it sometimes happens that the disease returns, perhaps from the adhesions not having been perfect. If there is any difficulty in bursting the cyst by a blow, it will be readily done, by first making a puncture with a small needle. Another mode is that of puncturing the ganglion with the point of a lancet, or cataract needle, and making use of

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[1] M. Bégin, Dict. de Méd. et Chir. Prat.

immediate and *firm* compression on the part: this mode is generally successful. The practice recently adopted with regard to hydrocele and ascites, might also be resorted to with benefit. By this plan, the needle is introduced into the collection of fluid, and a round aperture having been thus made in the cyst, the fluid escaping from it, but not externally, becomes gradually extravasated into the surrounding cellular tissue, whence it is in time removed by absorption. *Blisters*, and stimulating applications, such as painting the part with tincture of iodine, will sometimes cure the disease in this first stage; but in aid of them, it is necessary that the part be kept quite at rest: if the irritating cause be continued, success will not be obtained by these means. Sometimes the resolution of recent ganglions has been obtained by external applications, such as pressure by means of a metallic plate, mercurial frictions, discutient plaisters, especially that of hemlock, blisters, or the dilute liquid ammonia, &c.

Where the ganglia are the result of rheumatic inflammation, or other constitutional errors, they must be met by constitutional remedies. Under their influence the morbid state becomes modified; leeches to the inflamed parts are also very useful, and often cure the complaint. Ganglia, from these causes, appear and disappear with the variations of the disorder which produced them.

The subsequent stages are with greater difficulty cured, and the remedies are necessarily more severe than in the preceding.

Supposing the sac be large, and its parietes very thick, puncture will only prove useful as a palliative means. Mattress-makers, and housemaids, often apply for relief when the bursa on the patella is enlarged, not from any suffering thereby occasioned, but simply on account of inconvenience and deformity from the bulk. In such cases, if the person is obliged to continue working, the bursa may be punctured from time to time with a hydrocele trocar; but it must be remembered that the fluid re-accumulates very rapidly, and sometimes so much constitutional disturbance follows this very simple procedure, that death has been known to ensue. This occurs when suppuration follows the puncture in the interior of the sac, and its free egress is prevented by the small orifice, and has led to the practice of laying open bursæ throughout their whole length, and dressing with lint to induce suppuration, the use of setons, the application of caustic, and the excision of the bursa.

The free opening of bursæ is now very little practised. In some situations, as at the carpus, it would be obviously a dangerous proceeding, and one likely to be followed by the worst effects.

Mr. Aston Key uses the seton, and considers that mode of treatment not only the most effectual, but the most mild. The object is to bring about the suppurative stage, that the cyst may be obliterated by granulation.

When the suppurative stage has commenced naturally, the only treatment necessary, is to subdue the excess of inflammation, and to hasten its progress towards the permanent cure.

Caustics are deservedly rejected, for the safe, simple, and efficacious practice of excision. The bursal sac is generally so loosely connected with the surrounding tissues, that it is merely necessary to divide the skin, and separate the sac with the handle of the scalpel, taking care, of course, not to open it. The bursa on the patella and olecranon are, however, firmly attached to the bone, and require careful separation with the knife. The only caution necessary in these operations, is not to remove too much of the integument, or the contraction of the cicatrix will interfere with the free motion of the neighbouring joint; and, on the other hand, not to leave a loose bag for matter to form in. Care should be taken also not to wound the tendons: some practitioners content themselves with making a small incision into the tumour, having previously taken care so to stretch the skin upon it, that when the fluid is evacuated, no access shall be allowed to the air. Moderate pressure is then kept up till the cure is completed.

Inflammation of the bursal thecæ of tendons.—The same laws which govern inflammatory action in the synovial membranes, and the distinct bursæ, whose structures we have above considered, are observed to prevail in inflammation of the bursal linings of the thecæ of tendons; but inasmuch as the latter are more extended, and more intimately connected with parts peculiarly affected by inflammation, diseased action commencing in them often leads to a train of symptoms, more severe in their immediate effects, and more disastrous in their consequences. On this ground I propose to speak of thecal inflammation apart from the previous subject.

The sheaths of tendons become inflamed from very slight causes; a trifling bruise, or what is more frequent, a prick from a pointed instrument, which, in other parts, would scarcely be felt, are enough to produce the most formidable attack of inflammation in this structure. Inflammation in these parts at one time assumes a severe and *acute* form, at others it is slow and insidious in its progress, assuming an entirely *chronic* character.

The *acute* thecal inflammation is very severe in all its stages. The pain at its commencement is very violent and of a tensive character, from the unyielding nature of the neighbouring textures, which soon become swollen; pressure is productive of the most exquisite pain, and an elastic feeling is communicated, as if fluid was situated beneath; with this there is a general redness of the skin, and sometimes a diffused erysipelatous inflammation.

If these symptoms are not arrested in a few hours, the formation of matter becomes certain, and the severity of the symptoms is much aggravated. The external appearances are perhaps not much changed at first, but very soon one part of the swelling becomes especially prominent. The pain, hitherto continued and violent, is now increased by the additional throbbing of suppuration ; and this change in the character of the pain is often quite abrupt ; it becomes scarcely tolerable, nothing seeming to have influence in appeasing it. At this time the constitutional disturbance is excessive. Irritation is excited to its highest point, and no relief whatever is obtained until a free outlet be given to the matter, which is anxiously demanded by the patient.

The *treatment* of such cases should be prompt in the early stage of the inflammation, and every effort is to be made to subdue it before suppuration is established. Leeches, fomentations, and poultices, are the chief remedies, with general depletion. So soon however, as suppuration is discovered, a free and full opening by incision, not puncture, must be at once made. The evil of delay is great, and the advantage of such an opening at the moment will fully compensate for the temporary pain of the operation. Poultices and fomentations should again be applied after the incision.

The slow and chronic case of thecal inflammation offers symptoms of a less formidable nature ; but it frequently happens, that out of such a case, with the apparently gradual and slow progress of inflammation in its first stages, all at once, and in a moment, perhaps in consequence of the formation of matter, the chronic character is changed to the most acute form. In such cases the same treatment must be adopted, viz. bold and decided incision.

Small chronic tumours are occasionally met with, situated over the tendons, giving to them a knotted appearance. These are of various hardness, and are most frequently observed on the flexor tendons of the fingers. These have their origin in the bursal lining of the thecæ, and are caused by friction ; they are commonly seen in cricketers or rowers, or persons who are much in the habit of handling or grasping rough instruments. They are slightly painful, and so long as they continue to be subjected to the irritation which produced them, they go on to enlarge. Sometimes they assume an active character, purulent matter is formed, and the inflammation spreading over the aponeurosis gives rise to the most painful and alarming symptoms locally, as well as high constitutional disturbance. Another form of chronic thecal inflammation is occasionally seen where the tumor is more diffused. I have found it extend along the whole course of a finger, the palm of the hand under the ligamentum carpi annulare, considerably above the wrist, the fluid extending throughout the swelling ; pressure above the wrist giving an impetus to the fluid at its opposite extremity, and vice versâ. Such tumours are produced by similar causes as those before-mentioned. They seldom take on inflammation of an active character. I have punctured these chronic bursal collections, and have found frequently purulent matter, mixed with the synovial fluid, or small white bodies, apparently of an hydatic nature, some of them having almost the consistence of cartilage. At the wrist the tumour is bilobed by the pressure of the annular ligament. They are apt by continuance to involve the whole hand in chronic disease.

Treatment.—The small knotty tumours are, if discovered early, generally removed by rest, and the application of straps of plaister applied for that object, and at the same time to aid their absorption by promoting some degree of pressure. In the event of failure of this plan, the application of the emplast. ammon. c. hydrargyro, similarly put on, generally answers well. Should the evidence of the formation of matter become clear, it will be necessary to make a free and full opening. The existence of pus should be clearly ascertained, so that any unnecessary incision may be avoided, which in the early stages of the complaint is hazardous. The elastic feel, the extreme pain on pressure, and constitutional disturbance, will be sufficient evidence of the existence of matter.

The diffused and extended thecal swelling just noticed is best treated in its early stage by small punctures, so as to evacuate gradually the contents, and by immediate compression of the part ; this a few times repeated, generally reduces the swelling, and strips of plaister, permanently applied, completes their cure. When suppuration has mixed with these swellings, a more free evacuation should be given, and the use of emollient poultices recommended for a time. The use of the vapour-bath for a quarter of an hour daily is very serviceable in reducing the swollen state of the hand, and in regaining its free use.

The bursa generated under friction or irregular pressure comes next under our consideration.

The *bunion*, or its complication with corn, is the diseased state here meant.

This structure consists of similar materials to the natural bursa, but the bag is not so perfectly formed. It has an external coat of condensed cellular membrane, and an internal lining, with a shining and secreting surface, from which a serous fluid is poured out. The bunion is formed by pressure exerted on certain parts, in a certain manner and degree. Pressure of every kind, or every degree, made on any part indifferently, will not however produce a bunion ; the fibrous structures solely have this unhappy privilege. To produce a bunion the pressure must be applied so as to receive a counter pressure : for instance, it would not be found on any yielding part, such as the muscles of the thigh, or the scrotum, but the most favourable part for its production is a projecting point of bone, which opposes the pressure from without ; the pressure must remit and not be permanent ; it must not be too severe or too long continued. It is well known that compression produces different effects, according to the manner and degree in which it is applied. Thus when it is exerted with sufficient firmness and duration, pressure is capable of effecting the absorption of the hardest structures; whereas, on the contrary, if applied in a less degree, and at irregular intervals, it produces deposit, or abnormal growth. In the one case the vessels of deposit are compressed, and growth is impeded, whilst at the same time those of waste are in continual action, and absorption is the necessary result. In the other case, the degree of compression is sufficient only to excite the arteries (the vessels of growth) and deposit exceeds the process of absorption. These effects are illustrated by the progress of an aneurismal tumour, on the one hand, which by its continued and daily increasing pressure, causes the absorption of even the bones themselves. On the other hand, a contrary result is manifested in the growth of a hernia. The size of the hernial tumour varies with the volume of its contents, therefore the pressure varies in degree; there is also but little resistance from the yielding structures against which it protrudes; these textures therefore become gradually thickened as the hernia increases. The parts on which a bunion forms are the projecting ends of bones, and mostly on the toes. It is generally produced by tight shoes or boots, which are worn for some hours of the day, and borne without much pain, and the tight shoe is taken off so that the pressure is for a time remitted. These circumstances limit the degree of pressure, so that it acts on the parts as an irritant. The cuticle becomes thickened, and the cellular and fibrous parts beneath consolidated and condensed, these changes forming them into the structure we are describing. The bunion is the bursa, with the cuticle but slightly thickened; the corn has an additional deposit of cuticle, with a bursa beneath it.

The bunion is liable to inflame and suppurate, becoming a very painful and troublesome complaint. The treatment of this affection is very simple: in the first stages to reduce the inflammation by rest and poultices, and relieving the part from pressure by mechanical means.

In the suppurative stage, to freely incise it, and cause the surface to granulate. The secreting surface is difficult to excite to granulation, but if it is not found to do so, the object will be accomplished by the application of the nitrate of silver, or a small quantity of nitric acid. In this case the destruction of the lining membrane is necessary to the cure.

Accumulations of fluid in the bursæ will be noticed under HYDARTHROSIS.

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C.

CACHEXY, (from κακὸς, bad, and ἕξις, habit, *cachexia*, Lat.; *Kachexie*, Ger. Wasting, or depraved alteration of the body. In the progress of medical language, this term has sometimes been used as signifying a particular disease, or as an accompaniment of disease in various forms, and hence the names, cancerous, scorbutic, and venereal cachexy, &c. Of late years, the necessity of rejecting vague terms altogether, or of limiting their value in order to a permanent usefulness of them, has induced Chomel and other pathologists to fix the meaning of cachexy, as the state of wasting consequent upon certain chronic diseases in their advanced stages; and in this respect, therefore, it differs from diathesis, which exists in the early stages, and may even be supposed to precede the disease itself, to which it may be regarded as a predisposing condition, while cachexy, on the contrary, is but the effect of the alteration produced in the organs of the body.

CÆSARIAN SECTION. See GASTRO-UTEROTOMY.

CALCULUS, from *calx*, *lime*, Lat.; λίθος, Gr.; *calcul*, *pierre*, Fr.; *Stein*, Ger. The term CALCULUS has been used generally to signify such accidental, solid, and unorganized concretions, as are produced within the bodies of living animals. Calculi are, therefore, as might have been presumed, of very different kinds; different in their mode of origin, in their nature, and in their effects upon the economy in which they are formed. The more important and interesting, and those also to which the title calculus is most properly applied, are encountered in the ducts of the different secreting glands, and in the course of the intestinal canal. Calculi are, for instance, occasionally found in the lachrymal duct, or sac; they occur more frequently in the ducts of the salivary glands, still more commonly in the biliary ducts and gall bladder, and with like, or perhaps, even greater frequency, in the course of the excretory canals of the urine. Calculi of the intestines are comparatively rare in the human subject; but they are common enough among the lower animals, especially the vegetable feeders, in which they generally consist of masses of hair, or of the indigestible woody fibre of their food matted together and agglutinated by means of mucus and a salt of lime. It is to the calculi produced by deposition from the various secreted fluids that attention will be mainly directed in the following article.

The fluids secreted by animal bodies invariably contain some portion of saline or concrescible matter dissolved in the watery menstruum, which, in every case, composes their principal mass. These saline and concrescible matters, as they are of various kinds, so they also possess very various degrees of solubility, and are therefore liable, in different degrees, to be precipitated from their menstrua, and to assume the solid form which belongs to them essentially. The conditions favouring this precipitation, speaking generally, are few and simple. It is enough that the concrescible matters of any secretion, be produced in excess, with reference to their solvent media, either absolutely or relatively; the menstruum being deficient in quantity, the solid matters remaining in the normal proportion, precipitation is apt to occur; or, otherwise, the menstruum remaining normal, but the solid matters being produced in excess, precipitation is again liable to take place. The states of system, however, which lead to the elaboration of fluids of such a constitution, as renders precipitation from them, not only possible, but, in certain cases, inevitable, are extremely obscure. The bile, for instance, is in general a thin, slightly glutinous, and transparent fluid, indisposed to let fall its solid constituents; but it is sometimes elaborated of the consistence of pitch, and disposed, not merely to deposit its concrescible elements here and there, or at some particular point, in the course of the gall ducts, but to solidify within these, almost from their commencement in the secreting granules of the liver. In like manner the urine is in general a homogeneous, watery, and perfectly transparent fluid, letting fall little or nothing, even after becoming cold and standing at rest for several hours; but in particular instances we observe this fluid produced, so highly impregnated with concrescible matter, that deposition of this takes place, even within the secreting tubuli of the kidney, at a distance from their terminations in the papillæ of that gland. It is, in fact, only of late that pathologists seem to have felt the necessity of investigating particularly the state of system which leads to calculous deposition. Almost up to the present moment, the spirit which has guided inquiries in regard to calculus generally, has unquestionably been far too purely either chemical or mechanical. An acquaintance with the chemical constitution of calculi was indeed necessary; but as practitioners of medicine, it is obvious that we have done little to advance our available knowledge, when we have discovered that a concretion consists of phosphate or carbonate of lime, of lithic acid, or cholestrine, as the case may be; neither, in fact, have we approached the subject of calculus, in the whole of its more interesting and important bearings, when we have come to conclusions in regard to the best method of removing concretions from the places in which they are lodged. There is matter for inquiry which ought to precede every consideration having regard to the chemical composition of a calculus, or to its removal by medical or manual interference; the state, to wit, of the organs at large, the sum of whose functions constitutes the life of the individual, and the state of that organ in particular, whose derangement, among other effects, is productive of calculous deposition. It is, undoubtedly, in regard to the concretions which are formed from the urine, that our knowledge is farthest advanced; but when we ask ourselves what we know of the state of kidney which is connected with the various forms of deposition from the product of its activity, the urine, we are compelled to answer, next to nothing; and with reference to the derangements of the liver and other secreting organs, which lead to the formation of biliary and other calculi, we unhesitatingly admit our entire ignorance. A more careful and methodical study, in particular, of the urine in the course of all diseases, and of the condition of the kidney, associated with its various abnormal kinds, will surely do much to clear away the obscurity that yet surrounds the entire subject of renal pathology.

Salivary Calculi.—The saliva is occasionally elaborated very rich in concrescible matters. This is generally proclaimed by the rapidity and constancy with which an earthy-looking deposit, universally known under the name of tartar, takes place upon the teeth. But deposition is also apt to occur within the ducts of the salivary glands, and there to give rise to concretions which, sooner or later, by causing obstruction, or exciting inflammation and suppuration, require the interference of the surgeon. Salivary concretions are met with of very different sizes, from the magnitude of a millet seed to that of a filbert or almond. They are probably encountered more frequently in the ducts of the submaxillary, or sublingual glands, than in that of the parotid; although they have also been met with there in many instances. Often there is but one concretion in the duct; sometimes there are several; and now and then the ducts, from their termination on the mucous membrane of the mouth, to their most delicate ramifications in the substance of the secreting gland, seem filled with them.

The symptoms of salivary concretions are generally swelling and pain in the region where they are deposited. Sometimes they obstruct the ducts at their orifice; and when that of the sublingual gland is the one affected, we have the disease called *Ranula* produced. In these instances the calculus can very commonly be felt in the cavity of the mouth, and then there is no doubt in regard to the nature of the disease. But the calculus is frequently situated more deeply within the duct, and then its existence is often first suspected, when it has given rise to inflammation and the formation of an abscess. There is an interesting case of this kind related by Walther[1]. A patient had for some time complained of a painful swelling, situated at the upper part of the neck, immediately under the angle of the lower jaw. This went on to suppuration, and had finally to be punctured, when a large quantity of matter made its escape. The opening, however, could by no means be brought to close; on the contrary, it became fistulous, and there was a perpetual oozing of a thin watery fluid from the wound. Examined with a probe, a hard, gritty substance was discovered, and the wound being enlarged, a salivary concretion of more than half an inch in length, was extracted, after which, with proper care, the patient recovered completely. In another case, the particulars of which have been given by the excellent writer just quoted, there was so much pain, enlargement and induration of one of the submaxillary glands, that he was led to conclude, though no more than one small calculus was passed, that the whole of the ducts were filled with concretions. Acting upon this impression, the patient was put upon a course of carbonate of potash, of which he took twelve grains daily, in cinnamon water, and with the effect of gradually reducing the hardness and size of the affected gland.

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[1] Journal, B. viii. S. 173.

The composition of salivary calculi appears to vary little. They have generally been found to consist principally of phosphate of lime, united or not with smaller portions of the carbonate of the same base, and with more or less of an animal matter which seems to play the part of a cement.

The calculi which are occasionally encountered in the duct of the pancreas are, in all probability, of the same essential nature as those of the salivary glands, and are produced under similar circumstances. Pemberton found them entirely soluble in muriatic acid, with the disengagement of a large volume of carbonic acid gas, which seems to point to the presence of a considerable quantity of carbonate of lime in their constitution.

Biliary Calculi.—*Cholelithi.*—These calculi are most commonly met with in the gall-bladder; but frequently also in the biliary ducts at every point in their course—the ducti hepatici, ductus cysticus, and ductus choledochus communis. They are also occasionally met with in the stomach and intestines, and are constantly observed passing away by stool. Gall-stones are indeed far more common morbid products than is generally suspected: they are every day met with in the bodies of those who during their lives had never been suspected to labour under anything of the sort, and who died of diseases altogether unconnected with the liver.

Biliary calculi vary in size, from that of coarse sand or grit, up to that of a pullet's or duck's egg, and in numbers from one, two, or three, up to many hundreds. When numerous, they are small; very large biliary calculi are commonly single, and generally of a rounded or ovoid form; when they are numerous, they are always polygonal, and of very irregular shapes. Few of them are heavier than water, and most of them swim in that fluid; as they are of different kinds, however, so some of them are found of a specific gravity superior to that of water.

Biliary calculi are mostly of a brownish, or dark greenish-yellow colour. But they are occasionally seen blackish, of a light yellow, of a pretty pure white, and variegated. They differ considerably in the state of their external surface; generally they are smooth, and unctuous to the feel; sometimes they are rough and nodulated. When cut through, or broken, they are commonly found to consist of concentric lamellæ on the outside, and in the centre, either to have a radiated crystalline-looking, white-coloured nucleus, or a mass of a darker hue, without any determinate arrangement of particles; occasionally entire calculi are met with which have this homogeneous structure. The laminated external portion, in one case of biliary calculus, when it exists, bears a large proportion to the nucleus; and in another, the reverse of this obtains.

In regard to their chemical constitution, biliary calculi seem referable to three grand species, which, by one of the latest chemical writers on the subject[1], have been denominated *Cholesterine calculi*, *Mellitic calculi*, and *Inspissated bile calculi.*

Cholesterine Calculi have generally a white colour, and a crystallized, shining, lamellated structure. Sometimes they show a lighter, and sometimes a darker shade of brown, owing doubtless to the presence of bile mingled with them, in various proportions. These calculi are by no means common, neither are they of any great magnitude (the largest met with has scarcely exceeded a hazel-nut in size), and they are generally spherical in figure, from there being seldom more than one found in the same gall-bladder. They are exceedingly light,—the substance of which they consist, cholesterine, having a specific gravity considerably under that of water.

Mellitic Calculi. — These are by much the most common species of biliary calculi. They have their designation from their colour, which closely resembles that of honey of a deep colour. Mellitic calculi are generally polygonal in shape, occasioned by mutual pressure, for it very rarely happens that where one calculus of this kind exists several are not present. When we find the gall bladder and biliary ducts crammed full of calculi, they are almost certainly of the kind now under consideration. Mellitic calculi are generally smooth on the surface, which also feels soft and unctuous. When broken, they generally exhibit a thin outer crust, composed of concentric laminæ, crystallized in small rays, inclining towards the centre. These crystalline layers are cholesterine; the nucleus or central mass has usually the appearance of granulated honey. In point of chemical composition, about nineteen parts in twenty of mellitic calculi consist of cholesterine; the remaining part appears to be picromel and other animal matters which have not been particularly examined. Notwithstanding the large proportion of cholesterine in the composition of the mellitic biliary calculus, this principle must exist in a different state—a state of greater condensation—than it does in the proper cholesterine calculus; for the specific gravity of the two kinds of calculi is widely different. Instead of being lighter than water, the mellitic calculus is considerably heavier, being in the proportion of 1061, to water as 1000.

Inspissated Bile Calculus—This is one of the rarer kinds of calculus; it is, in fact, much less frequently met with than either of the other two kinds. The concretion of inspissated bile is of a yellow colour, it contains little or no cholesterine, but seems to consist almost entirely of the bile reduced to a state of solidity. The gall-stones of oxen, which are in use as a yellow pigment in the arts, seem to be referable to this species of calculus. They consist of the yellow matter of the bile, mixed with minute traces of bile, which may be separated by water. When thus washed, they become tasteless, and are insoluble both in water and alcohol.

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[1] Dr. Thomas Thomson, in Cyclop. of Pr. Med. Art. Calculus.

These, however, are by no means all the kinds of biliary calculi that have been encountered. Some, for example, have appeared on analysis to consist almost entirely of carbonaceous matter, and a few have contained little else than the phosphate and carbonate of lime. Although the physical qualities and chemical composition of gall-stones are perfectly known, we are altogether unacquainted with the vital conditions under which they are produced. The varieties in the appearance, structure, colour, and chemical composition of the concretions, seem of themselves to indicate that these conditions must be different in different cases, and the analyses which have been made of the bile produced in certain diseased states of the liver, point to alterations in the secreting organ itself, as the efficient cause of the production of biliary calculi. Thenard, for instance, found the bile elaborated by a liver which had undergone the fatty degeneration to be albuminous; in one case in which this degeneration had occurred to a great degree, the secreted fluid was simply diluted albumen, it had lost every one of its qualities as bile; and Bizio[1], in analyzing a quantity of bile where great changes had been produced by disease, discovered more than one entirely new substance in its composition, particularly one which he named *Erythrogene*, from the fine purple colour which it acquired under certain circumstances. The principal component of biliary calculi, cholesterine, is itself formed in extremely small quantity in healthy bile; in the bile of the youthful, indeed, it has been sought for in vain by some distinguished chemists, so that its presence may, under any circumstances, be held as an evidence of a pathological condition.

Biliary calculi are comparatively rare in the earlier and middle periods of life; they are, on the contrary, extremely frequent as age creeps on. Women, it is generally agreed, are much more frequently the subject of gall-stones than men, and corpulent persons generally appear to be more liable to them than those of spare habit. Sedentary occupations and confinement within doors, undoubtedly predispose to them; they are well known to be frequent among the tenants of prisons and workhouses, and Glisson[2] long ago remarked, that our domestic animals, our kine and oxen in particular, were much more frequently affected with gall-stones in winter than in summer; and that the first effects of the purging quality of the new grass, when they were driven out of the house in the spring, was very often to bring away a number of these concretions. The depressing passions have also been held to favour their production in a peculiar manner.

The *symptoms* occasioned by calculi contained within the biliary ducts and bladder vary greatly in different instances. Sometimes the presence of gall-stones during life has never been suspected, when, after death, they have been found in great numbers, and of large size; and again, though single, and of no great magnitude, they often prove the cause of most exquisite suffering. Persons who are known to have passed gall-stones, have very generally been observed to complain of some degree of uneasy feeling, of weight and fulness about the right hypochondrium, and deep in the epigastric region, long before they began to suffer from any positive or severe pain in these regions. They have also laboured habitually under occasional weakness of stomach, and torpor of bowels. Sometimes the first symptom that attracts attention, is a deep seated pain in the epigastrium, shooting through to the back, or extending upwards to the right shoulder: this pain is apt to be accompanied with nausea and vomiting; and if the conjunctivæ at the same time become suffused with yellow, and the pulse keep quiet, there will be little reason to doubt the presence of biliary calculi. The pain and accompanying symptoms occur of every degree of intensity; sometimes they are slight; in other cases most severe. The pain, for the most part, has an intermitting character, but the remissions are of very variable duration, sometimes of considerable length; and again, scarcely exceeding a few seconds or minutes, so that some patients have no respite from the torture they endure. The entire attack, too, varies greatly in its duration in different cases. When it is short, the patient soon recovers his wonted health and spirits; the feeling of depression subsides as the evidence of the accompanying jaundice disappears, the blood is freed from the presence of the bile that contaminated it, and speedily all is found precisely as it was before the attack. When this has been of long continuance, however, patients often remain shattered, and in indifferent health for a very considerable period of time. Occasionally gall-stones, even of considerable size, pass along the biliary ducts with very little pain; they have indeed been repeatedly discovered in the alvine evacuations, where their existence had not once been suspected. Sometimes gall-stones make their way out, not by the natural ducts, but by exciting inflammation and ulceration of the gall-bladder and ductus choledochus communis; they are thus discharged into the intestines, sometimes unhappily into the cavity of the peritoneum, and sometimes they make their way to the surface, and are evacuated among the contents of a biliary abscess. It is in these latter circumstances that biliary calculi become the objects of surgical interference.

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[1] Meinecke, Journ. f. Chemie, 1823, s. 123.

[2] Anat. Hepatis, cap. 7.

With regard to the *treatment* of the symptoms attending the passage outwards of biliary calculi, all are agreed that we possess no means of dissolving or disintegrating these concretions. Our principal efforts ought to be directed to promote their discharge. But the pain which the patient is suffering when we are first summoned to a case of biliary calculus, is usually so great that our first object very generally is to endeavour to relieve this. Opium is the medicine upon which we rely under such circumstances; and if aught will assuage severe pain, it is solid opium, in a sufficient dose. Opium, however, sometimes fails to bring relief; and then we have been recommended to try the effects of a full dose of the aqua lauro-cerasi and laudanum mixed together. The warm bath is also constantly to be employed; sometimes a large bladder, filled with ice, laid over the epigastrium, has brought relief after every thing else has failed. It is also occasionally necessary to have recourse to bloodletting, especially when the pain has become fixed in a point, and this is found to be tender even on the gentlest pressure being made.

The pain somewhat appeased, purgatives are the medicines upon which we place our chief reliance for getting rid of gall-stones. From five to ten grains of calomel, in combination with one or two of opium, followed by the common senna draught with salts, is probably the best medicine to begin with; and indeed the same formulæ may be continued and repeated as often as there is occasion for them. Purgatives are unquestionably advantageous, solely from their power of exciting the secerning organs generally, and the liver in particular. There is a flood of bile, poured out behind the calculus, which must have great influence in urging it onwards. In France, the popular and routine prescription, in cases of gall-stone, is a mixture of sulphuric ether and oil of turpentine. This is, in all probability, prescribed with a view to its solvent action upon the calculi, but it owes its efficacy and its reputation entirely to its antispasmodic and purgative properties. Graduated and regular exercise, as soon as it can be borne, is very much to be recommended; and if the patient's circumstances are such as will enable him to remove for a season, to the site of one or other of the gently aperient mineral waters, there is no course that can be advocated, more likely to prove of permanent benefit to him. When gall-stones excite inflammation and ulceration in the passages within which they are confined, and show a disposition to make their way outwards, an opening should be made for them as soon as consolidation is believed to have taken place between the internal canals and the abdominal parietes. In this way, as many as 100, and even 140 gall-stones have been got rid of; and though the openings have generally remained fistulous for a considerable length of time, still they have always closed in the long run, and the cases have finally done well.

Urinary Calculi.—*Calculus, stone, gravel; pierre, gravelle*, Fr.; *Harnstein, Gries, Harngries*, Ger.; *pietra*, Ital.—Few subjects have attracted a larger share of general attention, or been held of higher interest than that which involves a consideration of the formation and treatment of urinary calculus. The earliest records we possess of medical experience, show that practitioners were familiar with the symptoms induced by calculous complaints. But the entire pathology of the disease, and the very accurate knowledge now possessed of the chemical nature and variety of the concretions formed from the urine, and of the circumstances under which deposition from this fluid takes place, is the product of very recent times. The true principles upon which the treatment of these diseases is to be undertaken, is also the offspring almost of our own day.

In no department of practical medicine are we so much beholden to chemistry as in this; indeed, until Scheele discovered the lithic acid, in the year 1776, no step in advance could with certainty be made. By this discovery the Swedish chemist had the distinguished honour of directing enquiry into the proper path; it was Wollaston, who made the next onward step. In the year 1797 he published a paper "On Gouty and Urinary Concretions," in which he defined the true nature of the *chalk stones* of gouty subjects, and the elementary composition of three species of urinary calculi, in addition to that consisting of lithic acid already discovered by Scheele, namely, the calculus of the *mixed phosphates of ammonia, magnesia, and lime*, that of the *oxalate of lime*, and that of the *phosphate of lime*. In this year also were published Mr. Cruikshank's observations on the urine in various diseases, as an appendix to the second edition of Dr. Rollo's work on Diabetes. These observations of Mr. Cruikshank are highly interesting, and were noticed or translated in most of the Continental periodicals of the time. In 1799, Fourcroy and Vauquelin published their paper on urinary calculi, going over the ground already trodden by Scheele and Wollaston, and adding a knowledge of one new calculus, that, namely, of the *urate of ammonia*, to those previously described. In 1810, we again find Dr. Wollaston in the field, he having in this year discovered and described a calculus of a peculiar substance, capable of combining equally with alkalis and acids, which he named *cystic oxide*. In his "Essay," published in the year 1817, Dr. Marcet described two new calculi, the *xanthic oxide* calculus, and the *fibrinous* calculus. Although boasting of no new discovery, the year 1821 is remarkable for the publication of Dr. Prout's work, entitled, "An Inquiry into the Nature and Treatment of Diabetes, Calculus," &c. (2nd Ed. 1825.) The name of Dr. Bostock also requires particular and honourable mention in this place. His contributions to the *chemistry of the urine* in various pathological states of the system, stand almost alone in the annals of European medical literature, during a long series of years. He is the proper and immediate successor of Mr. Cruikshank in this field of enquiry. The analysis of the urine and other fluids, which form part of Dr. Bright's excellent work, entitled, "Reports of Cases," &c. are mostly by Dr. Bostock, who has the honour of having been the first to discover urea as a constituent of the blood in cases of diseased kidney. He speaks of it as "an animal matter, possessing peculiar properties, being partially soluble in alcohol, and acted on by nitric acid in the same manner as urea[1]." The caution of the philosopher alone prevented him from calling this matter "possessing peculiar properties," &c., by its proper name. That it was urea has been amply confirmed by Dr. Christison[2], who found it in considerable quantity in the blood of several patients labouring under dropsy, with the elaboration of albuminous urine.

In entering on the subject of urinary calculus, it is indispensable to begin with the consideration of the various morbid states of the urine, which are connected with their formation and growth. It were better indeed, were this possible, to treat immediately of the organic, or at least dynamic changes that must needs occur in the kidneys themselves when they act amiss; but in the present state of our knowledge this is impossible; in regard to the kidneys, we are compelled to assume altered conditions in the product of activity, as evidence of an altered or deranged condition in the agent: we know nothing of the state of the kidney immediately, which is connected with the elaboration of the great majority of abnormal species of urine. It is in reference to the production of albumen almost alone, that the *pathological anatomy* of the kidney has made any progress in connection with the indications of *perverted function* afforded by preternatural states of the urine.

Perfectly healthy urine in the human subject scarcely lets fall any precipitate save a slight mucous cloud, until it begins to be decomposed by standing. But very trifling and transient disturbances of the system suffice to destroy this criterion of healthiness in the product of the renal function. In fact, we cannot have our circulating and nervous systems stimulated by company, nor the organs of digestion called upon for an extra effort by a little more wine, and a somewhat fuller meal than usual, without observing the urine next day to be of a high colour, to become turbid after it has stood for some little time, and by and by either to let fall a powdery precipitate of various shades of colour, or to deposit a quantity of reddish-brown crystals on the bottom and sides of the utensil. Sedimentary urine, however, is observed to be the attendant upon a considerable variety of continuous morbid states of the system generally, as well as of the kidney in particular. The sediments, moreover, are by no means always of the same nature as those presented in the accidental circumstances mentioned; they differ entirely in their appearance and chemical composition, and are even indices of dissimilar and very opposite pathological conditions of the body.

Sedimentary urine may be conveniently spoken of under two distinct heads, in conformity with the two principal orders of salts which form the precipitates, and, as it happens, with the two distinct states of constitution with which they are severally associated: First, that in which the lithic acid and the lithates, especially the lithate of ammonia, the lithic oxide, the cystine, and the oxalate of lime, form the precipitate; and second, that in which the phosphatic salts, namely, the ammonia-magnesian phosphate, and the phosphate of lime, compose the deposit.

Sedimentary Urine in which the deposit consists of the Lithic Acid and the Lithates.— Of all the kinds of sedimentary urine this is by far the most interesting and important, in as much as upon its occurrence depends certainly in two cases in three the first step in the formation of urinary calculi, or stones in the kidney and bladder.

The urine from which the lithic or uric acid is deposited in the shape of crystals, as frequently happens, is commonly of a high colour, having something of the tint of a rich golden-coloured sherry wine. It has what may be styled the peculiar sensible properties of urine, in an eminent degree, the deep colour alone bespeaking the abundance of the principle upon which these depend; for both urea and uric acid uncombined with the colouring and odoriferous matter of the urine, the *urodmechrome*, as it might be called, are colourless, and without smell. It is not necessarily of very high specific gravity. The writer has often found urine which was depositing, or had deposited lithic acid abundantly, of the density of 1.018, 1.020, and 1.022. It is quite bright when passed, and generally communicates a sensation of comfortable stimulation to the urinary passages as it is voided. Sometimes this sensation is exaggerated, and then the urine feels hot to the urethra. It is only as the fluid cools that the crystalline particles of the lithic acid make their appearance; and as they subside quickly, have themselves a certain degree of transparency, and principally increase in size after they have reached the bottom and sides of the utensil or recipient; unless they are extremely abundant, they do not cause any very great diminution of transparency in the fluid.

When collected, by decanting off the supernatant urine, and dried, the lithic acid thus deposited appears in the guise of a parcel of brilliant crystals, which seem to be four-sided prisms, very like sea-sand or muscovado sugar in appearance, but drier and more gritty, of a brownish-red colour of various shades of intensity, being in some cases as dark as wainscot or mahogany, in others of a light brownish-yellow, and in some rarer cases nearly white. These crystals are very little soluble in water. Dr. Prout failed to dissolve 1 part of lithic acid in 10,000 parts of cold water. Dr. Henry, on the contrary, states that 1 part is soluble in 1,720 parts of water at 60° Fahrenheit, a discrepancy which Dr. T. Thomson[1] very happily explains by supposing Dr. Henry's statement to express the *quantity* of lithic acid which water will hold in solution, the attraction of aggregation of the substance being destroyed; Dr. Prout's the *power* which water possesses to destroy the attraction of aggregation. Chemists have in various ways attempted to account for the circumstance of a substance so insoluble as lithic acid being held dissolved in such quantity, as it frequently occurs in the urine. Proust[2] was the first who maintained that the lithic acid of the urine existed in combination with ammonia, and was made soluble in the fluid from this circumstance. This explanation has been adopted by Dr. Prout, by whom the existence of free lithic acid in the urine is denied *in toto*. The ratio, indeed, in which lithic acid and water are commonly enough present in urine, namely, that of 1 to 1000, makes it impossible that solution should take place, even allowing the highest estimate of the solubility of lithic acid to be correct. According to Dr. Prout, it is always present in combination with ammonia, and occurs as a super-lithate of this base. But the simple fact that lithic acid in combination only with a little colouring matter, is constantly deposited from the urine, seems of itself a sufficient answer to this view; and farther it happens, unfortunately for its stability, that the addition of a solution of caustic ammonia to urine, is followed, in the first place, by the precipitation of the phosphates, and after the lapse of a few hours by that of the lithic acid also so completely, that an acid subsequently dropped into the filtered fluid causes no further deposit of this substance[3]. Wetzlar, who particularly insisted on the above facts, in order to get over the difficulty presented by the insolubility of the lithic acid, himself maintained, that it existed in the urine in combination with soda. But lithate of soda is itself so extremely insoluble a salt, that the matter is not much mended by the supposition; besides, later researches in chemistry will not suffer it to be entertained, although it is interesting to know that a solution of lithate of soda will bear a considerable dose of lactic acid, the free acid of healthy urine according to the analysis of Berzelius, without undergoing decomposition[4]. By others, the lithic acid has been held to be rendered more soluble by the presence of the saline bodies which occur along with it as constituents of the urine. But direct experiment is against this notion. Dr. Duvernoy[5], of Stuttgardt, appears, however, to have solved this difficult question at last. He has shown, in a very satisfactory manner, that it is upon the presence of the peculiar odoriferous and colouring principle of the urine that the solubility of the lithic acid, and even of the superlithate of ammonia, mainly depends. He dissolved two grains of lithate of soda in between two and three ounces of hot distilled water. The addition of a few drops of an acid of more powerful affinity instantly caused the precipitation of the lithic acid in small crystalline plates. But on dissolving the same quantity of the salt in a like measure of fresh urine, Dr. Duvernoy found that he could add the stronger acid till the mixture reacted powerfully on litmus paper, &c., without the slightest immediate precipitation of the lithic acid taking place. It was only after the lapse of several hours that the fluid began to grow turbid, and the lithic acid to be deposited in the shape of crystals and impalpable powder. Again, he found that if to a saturated solution of lithic acid in boiling water so much of the proper colouring matter of the urine be added as will give to the fluid the hue of somewhat concentrated urine, the acid, instead of being precipitated as the mixture cools, will continue in solution long after it has become quite cold. Neither does the addition of a stronger acid to this compound fluid, even when cold, cause any immediate deposit of lithic acid; this only takes place after an interval of many hours[1].

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[1] Reports, &c. vol. i. p. 84.

[2] Edinb. Med. and Surg. Jour. vol. xxxii. p. 285.

It rarely happens that the lithic acid is deposited from the urine in the crystalline form alone. The acid, still in state of comparative freedom from foreign admixture, often appears, in the shape of an amorphous sediment of a tawny, reddish-brown or brick-dust colour. Very commonly too, the lithate of ammonia, and occasionally the amorphous deposit which occurs simultaneously with the precipitation of crystalline lithic acid, or follows this shortly afterwards, consists almost entirely of the lithate of ammonia, a salt which in some cases is deposited from the urine in extraordinary abundance. The sediment here is generally more or less of a cream or very pale tawny colour; sometimes it has a red or pink hue of various shades of intensity, an appearance that is owing to the presence of a new principle, the nature of which seems to vary, Occasionally the lithic acid combined with soda forms the matter of the sediment, which is then, for the most part, all but colourless. This last deposit has been most frequently observed in the urine of gouty subjects, a class of persons in which depositions of the same substance in the tendinous thecæ of the hands and feet are familiarly known to occur very commonly.

The deposits which occur in lithic states of the urine may be arranged according to their colour and state of aggregation, so as to be taken in at one view in the following manner:—

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[1] Art. Calculus, Cycl. of Pr. Med.

[2] Annales de Chimie, tom. xxxvi.

[3] Wetzlar, Beitr. zur Kenntniss des mensch. Harns, &c. Frankft. a. M. 1821.

[4] Wetzlar, l. c.

[5] Chemisch-medicinische Untersuchung des menschlichen Urins. 8vo. Stuttg. 1835.

[1] Op. cit. p. 16.

Red crystalline Sediment composed of	Lithic acid and the colouring matter of the urine. The crystals are rhomboidal prisms, which in the field of the microscope, appear under the form of pretty regular lozenges, generally of a beautiful topaz-yellow colour singly. Vigla[1] and Quevenne.
Lateritious, red, or reddish-brown Sediment, composed of	Lithate of ammonia; purpurate of ammonia and soda; colouring matter of the urine; and occasionally an admixture of the earthy phosphates. Prout. Lithic acid combined with the colouring matter of the urine. Vigla.
Yellowish Sediment, composed of	Essentially of lithate of ammonia; a little lithate of soda, colouring matter of the urine, more or less of the earthy phosphates. Prout. Lithic acid combined with less of the colouring matter of the urine, than in the preceding form of deposite. Vigla.
Pink Sediment, composed of	Lithate of ammonia; purpurate of ammonia. Prout. Almost wholly of lithic acid; some lithate of soda; an animal matter, and a little phosphate of lime. Quevenne cum Vigla[2].

The recent crystallographic and chemical analyses of the lithic deposits of the urine, by Messrs. Vigla and Quevenne, would consequently lead us to conclude that these deposits were generally more simple in their constitution than they were found to be by Dr. Prout. They probably vary considerably in different cases.

Such deposits of lithic acid and its salts almost invariably take place on the termination of febrile paroxysms. They are, therefore, often observed to be critical; and their first faint indications are to be anxiously looked for in the course of severe inflammatory and bad febrile attacks. In the earlier stages of such diseases, the urine is scanty and high coloured, but does not deposit; at the height of the disease it often becomes neutral, sometimes positively alkaline, especially in typhoid fever; when the disease is about to abate, the urine resumes its proper acid qualities; by and by it shows a light cloud, which the microscope discovers to be caused by a crop of minute crystals of lithic acid.

Independently of every thing like active febrile disease, however, the urine often shows a singular disposition to deposit the lithic acid and its salts. There are two periods of life at which this lithic state of the urine in one or other of its forms is more peculiarly apt to present itself; these are infancy, and the years between forty and sixty. These ages may, therefore, be regarded as directly predisposing to a lithic condition of the urine; whilst every circumstance that tends to occasion an increase or excess in the acid and saline ingredients of this fluid relatively to its quantity, may be viewed as immediately tending to cause a separation of these matters from the state of solution in which they ought always to exist. We have seen how nearly insoluble was the lithic acid itself, and how very sparingly soluble were its salts; the most soluble of these, the lithate of ammonia, still requires something like 480 parts of water to effect its solution; so that we have but to suppose the quantity of lithate of ammonia in the urine to be accidentally tripled, which often occurs, to have of necessity a portion of it thrown down as a solid, the watery menstruum of the urine not being then in quantity sufficient to preserve the whole of the salt in solution[1]. And then it happens that the affinity of the lithic acid for the bases with which it occurs combined and by which its solubility is somewhat increased, is so slight, that even the weakest of the acids, the carbonic, citric, acetic, &c. are powerful enough to dispossess it, and effect its precipitation in a concrete form[2].

The most efficient cause in engendering lithic acid is indulgence in large quantities of animal and other kinds of nutritious food; and that which most promotes the separation of the lithic acid, either from the peculiar colouring matter, or alkaline base combined with which it is rendered soluble and innocuous, is the presence of a free acid in the body, whether introduced or engendered there.

These facts give a key to the right understanding of the whole of this most interesting subject; happily also, they afford an indication of what is needful to be done in order to correct the morbid states with which an excessive production and a tendency to the deposition of lithic acid within as well as without the body are connected.

Do we not in fact see the infant living on a highly azotised and peculiarly animal food, which has further a singular tendency to acescency, precisely the two conditions requisite to the production and precipitation of lithic acid? Can we wonder, then, that urine which deposits lithic acid and its salts, should be common in infancy? especially when we add that the children of the poorer classes who are most obnoxious to this state of urine, independently of their immensely larger relative numbers, are peculiarly open to all the other influences that are held favourable to the inducement of deposition from the urine—such as exposure to cold in consequence of scanty clothing and indifferent lodging, and to derangements of the stomach and bowels from coarse and improper food.

Again, when we regard the age between forty and sixty, the next period in human life that is marked by liability to the precipitation of crystalline lithic acid from the urine, we cannot fail to observe, especially in that portion of the community that subsists by manual labour, that the influence of excessive toil is beginning to be felt about this time? Exposure to wet and cold has now withered the skin, coarse food has impaired the digestive powers, hard labour has blunted the sensibilities, and the frame which but a few years before seemed knit to endure for an indefinite period already shows symptoms of decay. In the professions too, men begin to relax from their undue exertion. The simple meal no longer suffices. A man now begins to dine at his ease, to entertain and be entertained. The stomach is taxed to the performance of unusual duty, and not uncommonly taxed beyond its powers; the blood is fevered by strong drinks of every kind; the nervous system is excited by the presence of company, &c. &c. The pabulum of lithic acid is furnished to the kidney in abundance, febrile excitement leads this organ to exert its peculiar acidifying powers upon the matters presented to it, and imperfect digestion supplies an acid—all that was wanted to bring about the deposition which now so frequently occurs.

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[1] Etudes Microscopiques de l'Urine; L'Expérience, tom. i. Janvier, 1838.

[2] Op. Cit. p. 194.

[1] T. Thomson, Cyclop. of Pr. Med. Art. Calculus.

[2] Thenard, Traité de Chimie.

These causes are also productive of a positive decrease in the quantity of urine secreted, and thus we have an increase of the saline and acid ingredients of the urine, coinciding with a diminution of the menstruum in which they are carried out of the system. In infancy the deposition of lithic acid would unquestionably be more frequent than it is, were it not for the state of copious dilution in which food is then taken. And it happens fortunately, perhaps, that the unnecessarily large quantities of highly nourishing food in which grown men are so prone to indulge, are mostly associated with pretty copious potations of different kinds: good eating craves good drinking, and wine, beer, and tea and coffee, are always swallowed abundantly to allay the fever which heavy meals of highly seasoned animal food never fail to engender. Still the urinary secretion even under these circumstances is rarely found to be regularly in the ratio of the liquid imbibed. Animal food and strong drink seem to have a positive repressing influence on the secreting functions of the kidney. Very little urine is passed for twelve or eighteen hours after a debauch in meat rather than in drink. During all this time the function of the kidney is nearly in abeyance, and the salts of the urine are eliminated *suspended* rather than *dissolved* in that fluid. It has been remarked, too, that carnivorous animals, though they drink water freely, make but very little urine in comparison with the herbivorous tribes, many of which, living on succulent vegetables, rarely drink at all, and yet pass large quantities of urine[1]. A knowledge of this fact led Dr. Wollaston[2] long ago to propose that persons liable to gravel should follow a vegetable regimen; and Dr. Pearson[1] afterwards remarked that the calculous concretions of phytivorous animals never contained lithic acid, and followed Wollaston in recommending vegetable diet. The peasantry of Scotland and Ireland, who live almost entirely on vegetable matters, often of the coarsest kind, and drink nothing but water, actually labour under a kind of diuresis in contrast with their brethren of England, who live on bacon, and cheese, and wheaten bread, and drink little but ale or beer; and lithic urine and its consequences are rare out of the towns both of Scotland and Ireland.

Dyspepsia, or bad digestion, it has been asserted, is the most efficient cause of a lithic state of the urine. The agricultural population of Scotland suffer much from heart-burn and oppression after eating, yet their urine cannot be said to be lithic. We have moreover proof that something else than simple indigestion is at work in inducing a lithic state of the urine, in the fact, that whilst in the county of Norfolk one case of calculus occurs for every 21,000 of the inhabitants, and ten or twelve operations for stone have for many successive years been annually performed in the Norwich Infirmary, the disease seems to be entirely unknown in the county of Hereford, no patient during more than forty years having been received into the Hereford Infirmary labouring under stone, and no record of the operation of lithotomy ever having been performed within the bounds of the county being extant[2]. In Devonshire, too, the disease of stone appears to be very rare.

We cannot suppose that the inhabitants of Norfolk are peculiarly or more than usually afflicted with indigestion, and that the natives of Hereford and Devonshire are peculiarly or more than usually exempt from this malady. Peculiar local and atmospheric influences, some of which are appreciable, combined with certain specialities of diet, a very large share of the blame being ascribed to the latter, seem adequate to account for the prevalence of calculus, the consequence of a previous disordered state of the renal function, as an endemic disease in particular districts. Norfolk, for instance, is very much exposed to the piercing wind that blows over England from the east, and this must undoubtedly affect the skin to a very great degree, and thus influence the function of the kidney. In Norfolk, again, wheaten bread[3], hard dumplings, (masses of imperfectly fermented dough mixed with suet,) bacon, and cheese, washed down with thin, hard beer, i. e. a bitter infusion with a modicum of spirit and a considerable admixture of vinegar, constitute the diet of the inhabitants. In Herefordshire and Devonshire, the solid articles of sustenance are nearly of the kind mentioned as used habitually in Norfolk; the dumpling, however, is not so much of a staple, and in Devonshire broth is a common addition as an article of food. In both Herefordshire and Devonshire, however, the drink is different; cider is here consumed universally, and in large quantities, a beverage which, besides water, some acetic acid when old, and alcohol, contains a considerable quantity of malic acid and super-malate of potash. Now it is familiarly known that many fruits and their expressed juices,—the cherry, the strawberry, and the apple, among others, afford great relief in their season to persons labouring under gravelly and calculous complaints. Linnæus used to recover from his constitutional gout by indulging freely in the strawberry.

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[1] Magendie, Rech. sur la Gravelle, p. 25.

[2] Philos. Trans. 1797.

[1] Ibid. 1798.

[2] Smith in Med. Chir. Trans. vol. ii.

[3] "An unusually heavy meal of animal food or bread is invariably followed by a deposition of the lithate of ammonia from the urine." Prout, Inquiry, p. 118.

Such a drink as cider, therefore, is to be viewed as essentially different in its elementary constitution from the malt liquors so commonly taken as diluents in England. Vinegar as an article of diet, or disguised in malt liquor, as it invariably is when the drink is old, (and the connoisseur does not care to touch ale until it has acquired some degree of hardness or acescency from keeping,) is a most potent cause of the precipitation of lithic acid from the urine. In one of the districts of England where gravel and stone, and their antecedent, lithic urine, are extremely common, namely, in the poor country between Tunbridge-Wells and Lewes, the inhabitants are poorly fed, and look thin and sallow; but hard, i. e., stiff puddings, and *hard*, i. e. *sour* beer, are regular elements in their diet[1]. In some districts of the continent, where extremely thin and sharp wines are the ordinary drink of the community, as in the Prussian provinces on the Rhine, gravelly and calculous complaints are, as in cider countries, extremely rare.

That particular articles of food or drink have immense influence in producing that state of urine which leads to the deposition of crystalline matters, is happily illustrated by the following fact, communicated by Dr. Joshua B. Flint, of Louisville, United States, in his recent visit to this country:—Fifty years ago the city of Boston, United States, used to be noted for the frequent occurrence of stone; there was then no practitioner of any name, who had not been repeatedly called upon to perform the operation for its removal. At the present day, however, there is but one practitioner, Dr. Warren, who has ever performed lithotomy, and this not more than seven or eight times in the course of a long and active professional life, and only in two instances upon resident inhabitants of the city. Calculus is now an extremely rare disease in Boston. This remarkable change Dr. Flint ascribes to the discontinuance of *punch* as a beverage. Fifty years ago punch was the standard drink with all classes, and on all occasions,—every one drank this compound of lemon-juice, rum, and sugar; but at present no one drinks punch: a skilful hand at compounding a bowl is hardly to be found within the precincts of the city of Boston, tripled or quadrupled as it is in the number of its inhabitants from what it was half a century ago. Now it is quite certain that punch, of all the compounds taken into the stomach, is perhaps the most powerful in producing a state of urine which is followed by the precipitation of the lithic acid and the lithates.

No country in Europe suffered so much from gravelly and calculous complaints a century ago as Holland. One lithotomist is reported to have performed his operation at least 2000 times. At present calculus is not a very common complaint in Holland. The change is probably owing to the substitution of tea as a universal beverage for the spirits, or spirits and water, that used in former days to be consumed in large quantities, and by all classes of the community.

Whilst we admit then to its fullest extent the influence of diet on the state of the urinary secretion, we are not prepared to say that this influence is engendered through any derangement of the digestive organs in particular. Primary and habitual dyspepsia is for the most part accompanied by the discharge of pale urine that rarely deposits at all, and when it does the matter thrown down is of a kind which very rarely indeed concretes within the body so as to form gravel or the kernel of a calculus.

The more sedentary habits that creep upon us as we advance in life, and the diminished necessity that is generally felt for using so much active bodily exertion as formerly, are farther causes of the occurrence of the lithic urine, so frequently met with as years roll on. Dr. Wilson Philip in his experiments[1] found, that other things being the same, the deposit of lithic acid from the urine was much more constant and copious when he kept himself close to the house, than when he went abroad and used active exercise. Sir B. Brodie[1] relates, that a gentleman of his acquaintance never suffered any inconvenience from the free life he led in eating and drinking, so long as he took plenty of exercise, he being in the habit of rising early in the morning, walking lustily, and returning home to breakfast perspiring profusely. On a change of circumstances, however, in which he continued to eat and drink as before, but ceased to rise early and to take his long walks, he became subject to red sand in his urine, and to a scaly eruption of his skin. Some have even become obnoxious to the consequences of the state of urine that engages us, namely, gravel and calculus, after a confinement of a few weeks' or months' duration on account of an accident. Thus Van Swieten relates that a man who had lain on his back for ten weeks in consequence of a fractured thigh, suffered an attack of nephritic colic shortly after his recovery, and by and by passed a small rough calculous concretion. Nor did the mischief end here, for the individual became subject to recurrences of this malady ever afterwards.

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[1] It has often struck the writer, that the addition of a sufficiency of supertartrate of potash at the time of brewing, would give ale or beer the flavour of slight hardness whilst yet young and quite free from vinegar, and that even when it did become acescent from keeping, its liability to occasion mischief would be materially lessened by so simple a medication. He even fancies that the inhabitants of Norfolk, acting on this hint, may one day find themselves delivered from the demon in the shape of a stone which now dodges them at the heels. Brewers of malt liquors in general, would be doing well for the health of the community, if to each bushel of malt they added, before mashing, A HANDFUL OF COARSELY POUNDED GYPSUM. The fine wines of the Macharnudo Vineyard, at Xeres la Frontera, the property of the Domecq family, probably the most perfect wines in the world, are all made with this addition. The sulphate of lime seems to have the power of preventing the production of acetic acid. The superiority of well over river water for brewing, particularly for making ale that will keep long without turning sour, depends entirely on the sulphate of lime which it holds in solution.

[1] Inquiry into the remote cause of Urinary Gravel. 8vo. Edinb. 1792.

Another cause of a lithic state of the urine, and the deposition of the insoluble acid characterizing it, which was particularly insisted on by the late Mr. Earle[2], is local injury done to the kidney or to the lumbar region. A more common consequence of injury to the lumbar region, is the state of urine which will be particularly described in the next section; it is that in which the phosphatic salts are elaborated in preternatural quantity and deposited from the urine. Nevertheless, Mr. Earle has given several interesting cases, in which the lithic diathesis certainly followed injury to the region of the loins; and it is not unreasonable to suppose, that the effect of this may have been to induce in the kidney that peculiar morbid state which is marked by the formation of lithic acid in excess. In persons subject to the lithic acid diathesis, when it goes the length of a deposit within the body, we often have occasion to observe, that the uneasiness and pain complained of are confined to one side only. Were the malady entirely constitutional, both kidneys would be implicated; but gravelly subjects frequently go on for years, passing concretions from time to time from one kidney only. The state of the kidney in its individual capacity ought not, therefore, to be overlooked. This is an important hint, for which we are indebted to Mr. Earle, and which has probably been too much neglected in the medical treatment of calculous diatheses generally.

In his very ingenious Essay on Gravel, M. Magendie[1], among other causes tending to induce a deposition of solid matters from the urine, reckons a diminished temperature of the body, which he believes to be proper to the aged. By actual experiment he found the temperature of the axilla in men above sixty to be seldom above 36° C. or 96°.5 F. nearly. The urine projected upon the thermometer he found no higher than 30° C., about 86° F., or ten degrees of the latter scale under the temperature proper to the vigour of life. Ten degrees of temperature must certainly have some influence on the solvent powers of the urinous menstruum. These experiments of M. Magendie have been confirmed by others reported by M. Chevallier[2], who remarked that the temperature of the urine in children was low, that of adults higher, and that of the aged again low. The urine of a healthy man aged fifty-five was no higher than 33° C, or 91°.5 F.

There is still another cause of the production and precipitation of lithic acid and its salts from the urine, the importance of which cannot be overlooked in numerous instances, and which is probably of more moment than all the others put together. This is the inherent peculiarity of constitution which all testimony concurs in showing to be of the same essential nature as that with which gout is associated. Gout, however, is itself very uniformly the creation of easy circumstances and over-indulgence of the animal appetites of hunger and thirst. The laborious poor are rarely its subjects, and in the savage state, where life appears to be passed in a perpetual struggle for means to satisfy the cravings of hunger, the disease is unknown. The two constitutions, the gravelly and the gouty, as they are so commonly and so intimately associated, undoubtedly derive their origin from the same source.

In addition to these *internal* causes, inducing that state of urine in which the lithic acid and its salts are deposited, it is impossible to overlook the influence of certain *external* circumstances which have unquestionably a very potent sway over the same state of things. Among the principal of these is temperature. In lands and districts where the diurnal variations of temperature are small, calculous complaints, which may be said to be all but invariably consequences of a lithic state of the urine, are rarely met with. In latitudes and districts, again, where these changes are greatest, they certainly occur most frequently. Extensive annual variations of temperature seem to have less influence than sudden alternations of heat and cold from day to day, and great inequality in the temperature of the nights and days. Renal diseases of all kinds are very frequently referable to exposure to cold, and the state of urine in which lithic acid and the lithates are deposited is a common consequence of a chill of the body. The county of Norfolk presents generally an exposed and open surface; the alternations of temperature are great and sudden, and there is no district in England over which the east wind, the dread of the invalid and person of susceptible nervous system, sweeps more constantly or more searchingly than over Norfolk. Suppressions of the cutaneous exhalation, combined with the kind of food generally used, are in all likelihood the potent cause of those derangements of the urinary secretion, which lead to the superabundant elaboration, and deposit of some of its suspended, or dissolved but readily concrescible ingredients, within the body in that division of this country. Free action of the skin seems almost incompatible with the copious elaboration or deposition of lithic acid or the lithates. Dr. W. Philip, in his experiments already referred to[1] observed that the most acescent food, which, under ordinary circumstances, had the effect of causing a plentiful deposit of lithic acid, had no such influence when the due action of the skin was maintained by diaphoretics. Cold applied to the surface of the body does not merely increase the quantity of the watery menstruum elaborated; the solid matters are also augmented in a very considerable proportion, in the ratio, namely, of three to two[2].

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[1] Lectures on the Diseases of the Urinary Organs. 2nd Ed. 8vo. Lond. 1835.

[2] Med. Chir. Trans. vol. xi.

[1] Recherches sur la Gravelle, 8vo. Paris, 1818.

[2] Essai sur la Dissolution de la Gravelle. Paris, 1837.

The immediate cause of the precipitation of the lithic acid, especially when this takes place within the body, has been variously accounted for. Those who maintain that the acid exists in combination with ammonia, by which it is rendered more soluble, explain the occurrence readily through the agency of the free acid, which is always present in lithic urine. This free acid, say they, dispossesses the lithic acid of the base with which it is combined, and causes it to precipitate. The soundness of this explanation, however, is very questionable. First, the lithic acid separated from an alkaline base in this manner, is thrown down in a pulverulent or amorphous form, not in distinct crystals, as we perceive it to be, and when its consequences are alone to be apprehended. Then, there are great doubts in regard to the nature of the acid which can be spared to have such an effect. Dr. Prout supposed the muriatic acid to be the agent; but this acid has never been shown to exist in the urine, save already saturated with bases—ammonia, potash, and soda. The phosphoric acid has enough to do in holding the lime with which it is associated in solution. The lactic acid, the free acid of the urine, according to Berzelius, has been shown by Wetzlar to be the least efficient of all the acids in causing the precipitation of lithic acid from its state of solution in the urine. Finally, it is all but certain that the explanation of the precipitation of lithic acid from the urine by the agency of any free acid is erroneous. If the lithate of ammonia often occurs in the urine, it is no less certain that the free and uncombined lithic acid occurs there too.

Treatment.—The treatment of the lithic diathesis is happily perfectly understood, and the effects of well chosen remedial agents combined with attention to diet, &c. are probably, under no circumstances, worthy of more implicit reliance than when they are directed against the pathological state which is characterized by the deposition of lithic acid from the urine. As a preliminary, the circumstances surrounded by which the patient lives, must be taken particular note of, and all in these that is known to induce or to favour the malady from which he is suffering, must be removed. If he be a man in easy circumstances, or at all events accustomed to live highly, to drink some strong wine every day, to pass a sedentary or inactive life, engaged with his head rather than his hands, &c., he must be made aware of the connexion between his state and the kind of life he leads. He must be induced to abandon his very full regimen, to restrict himself greatly in the article of wine, and to give more occupation to his muscular system, and less to his brain. The proper functions of the skin ought farther to be secured by a due quantity of warm woollen clothing, and exposure to cold and piercing winds should be particularly avoided.

It is not always possible, however, to wait for the tardy effects of regimen upon the progress of disease; the symptoms are sometimes urgent; gravelly deposition had probably taken place and was going on, before we were summoned, and to delay were to make our patient run the risk of stone in the kidney and bladder. The state of system tending to this conclusion must be immediately altered. The most speedy means we have of doing this, is to lower the tone of the system by blood-letting and brisk purgatives. General blood-letting is seldom necessary in the kind of cases we are considering, nor indeed is it always well borne by the persons who are their common subjects. But local bleeding by means of cupping from the lumbar regions, to the extent of eight or ten ounces, will prove eminently serviceable in almost every instance. This should be immediately succeeded by the exhibition of a purgative dose of calomel combined with antimonial powder, the full effects of which will be secured by prescribing three or four drams of the soda tartarisata in infusion of senna, with half a dram of the vinum colchici, at the interval of an hour or two afterwards. These medicines ought to be repeated until the bowels are completely unloaded. The antiphlogistic regimen is meantime to be enforced; the patient should have nothing beyond slops and light farinaceous food for several days. He may, however, be encouraged to drink freely of rice or barley water, and he may take the common effervescing draught,—

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[1] Op. cit., p. 100.

[2] Chossat in Journ. de Physiologie, tom. v.

half a dram of the bicarbonate of potash or soda saturated with fresh lemon juice, three or four times a day with great advantage.

Under this treatment the high tension of the system will give way ; the pulse will be subdued in force and fulness, the alimentary canal will be unloaded, and the urine from being strongly acid, deeply coloured, and highly charged with readily concrescible matters, particularly lithic acid, will be rendered neutral or alkaline in its reaction, pale in colour, and copious in quantity, conditions exactly the reverse of those in which lithic acid is deposited, and indeed incompatible with its deposition.

In the first period of a plan of treatment of this kind, it is not uncommon to see a considerable quantity of crystallized lithic acid discharged from the kidney, an event which has been observed to follow with considerable regularity upon the use of some of the ordinary diuretics, such as the turpentines. Whether this discharge of lithic acid is to be regarded as critical, *i. e.*, as the *materies morbi* eliminated from the system by the kidney, or as a simple expulsion from the pelves of the kidneys of a quantity of concrete foreign matter, has been made the subject of question among pathologists. In some cases there seems little reason to doubt of the critical nature of the discharge ; in others, it is obviously the effect of the mechanical and chemical action of the diluents that are so uniformly prescribed when red sand has been observed to be passed along with the urine. Should any thing like uneasiness continue in the region of the kidneys, after the measures which have been specified have been enforced for some days, it may be well to try the effect of one or two doses of turpentine. If they have the effect of bringing away a quantity of sabulous matter, the relief experienced by the patient is always great ; and the good effects of the medicine may be secured by the subsequent use of gentle aperients, diluents, regulated diet, &c. We are not aware that serious mischief has ever actually happened from the attempts which are sometimes made, at all hazards, to induce such an elimination of lithic acid from the kidney, by combining the terebinthinate diuretic medicine with muriatic acid and opium. It seems just possible, however, that a course of this kind might lay the foundation of a renal calculus, with all its immediate and prospective miseries. We can hardly conceive a case, therefore, in which we should be inclined to adopt it ; certainly not one in which we should persevere with it longer than a day or two. We have better than purely empirical grounds to go upon in the treatment of such cases.

Should we be able to trace the morbid state of the kidney to local injury, should it even have supervened upon severe fatigue, in which the *reins* (the lumbar regions) were especially sufferers, as after hard riding, the affection may with benefit be regarded as being, to a very considerable extent, local in its nature. In this case, the repeated application of leeches or cupping-glasses to the loins, and then the insertion of a seton, will be proper, and hardly fail to prove of service. Indeed, as often as we observe repeated attacks of nephritic pain on one side, associated with a lithic state of the urine, we shall be justified in looking particularly to the state of the organ immediately affected ; and recent experience has shown that even the most deeply seated of the internal organs are very much more under the control of the remedial effects of counter-irritation than could readily, *a priori*, have been imagined.

The state of system which is proclaimed by the secretion of urine loaded with lithic acid, is one that is almost always much benefited by a course of mercurial alteratives and gentle aperients, continued for a considerable length of time. Four or five grains of the Plummer's or blue pill every other night, or twice a week, followed by a senna draught with Rochelle salts in the morning, will be found to have immense influence ; and with the regulated diet, principally consisting of farinaceous articles, and the other items in the treatment which have been indicated, would appear to be possessed of power enough even to eradicate the disposition to the peculiar morbid state under discussion,

But there is another, and, as it might be truly called, specific plan of treatment that ought not to be neglected in the lithic diathesis. This consists in the exhibition of the alkaline bicarbonates in a state of large dilution, or in a course of one of the mineral waters which contains a bicarbonated alkali among its saline ingredients. Sulphur is hardly if at all more potent against scabies, than the alkaline bicarbonates are influential against a disposition in the urine to deposit lithic acid. Taken at proper times, and dissolved in plenty of water, these salts are perfectly innocuous, and may be continued for months, and even years, not only without injury, but in many cases with great benefit to the general health. From half a dram to a dram of the bicarbonate of potash or soda (the soda is probably the more germane to the system) dissolved in from three quarters of a pint to a pint of thin mucilaginous fluid, should be taken two or three times a day according to circumstances, at periods as remote as possible from those at which meals are taken. Immediately before or immediately after a full meal, a large dose of either of these salts will not fail to interfere with the important process of digestion. Schwann[1] found that they destroyed the peculiar faculty of the Pepsin or the digestive element. Administered at the distance of two hours before a meal, they are abstracted from the stomach and carried off into the torrent of the circulation long before any food is taken, and the digestive process goes on unimpeded by their presence in the blood. If the patient's circumstances permit him to leave his ordinary place of residence or business, and betake himself to a watering-place for a few months, he can do this to greater advantage in no circumstances than when he is labouring under a lithic state of the urine. Our own country is deficient in mineral waters that are peculiarly adapted to such a case. But on the continent they abound. At the head of the whole may be placed the waters of Vichy, in the centre of France. No mineral water known contains so much bicarbonate of soda as the hot springs at Vichy; an ordinary tumblerful holds in solution nearly eighteen grains of this salt; and two or three glasses taken at intervals in the course of the day, are often sufficient to maintain the urine in a neutral or alkaline state, nay, the mere soaking in a warm bath of the water is sufficient to produce the same effect[1]. The waters of Mont d'Or, Carlsbad, Seltzers, Pyrmont, Obersalzbrunn, &c. have the same effect in different degrees; they each prove beneficial in such cases at all events. Where removal is inexpedient or impossible, we can supply the place of these natural alkaline waters to a considerable extent, by prescribing the bicarbonate of soda or potash in a proper quantity of thin barley-water, or in simple water impregnated with carbonic acid gas[2]. Fifteen or twenty grains of the bicarbonate of soda, dissolved in two ounces of water, having a half-pint bottle of our ordinary soda water (water charged with carbonic acid gas) poured over it, makes an artificial mineral water that is extremely pleasant to the palate, and is taken freely by patients. Could we but subjoin the benefits of the country air, healthful exercise, and relaxation of mind, that are always understood as elements in a visit to a watering-place, we should in general be able to dispense with a removal from home.

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[1] Ueber das Wesen des Verdauungs-Processes, Berl.; also Mueller's Physiology, transl. by Baly, p. 545.

Chemical examination of lithic urine, and its deposits.—A known quantity, say 1000 grains of the urine, after it has stood for several hours, is to be poured upon a filter of fine bibulous paper, and the fluid separated from the solid parts. Another portion of the urine may be tested for any additional lithic acid it may contain, by having a few drops of muriatic acid added to it. The precipitation of the lithic acid may always be immediately secured by drying well and warming gently the glass vessel into which the urine about to be examined is poured, or by rubbing the inner surface of the vessel containing the urine after a few drops of acid have been added to it, with a rod of wood[1]. The colour of the deposits is best ascertained whilst they are still wet upon the surface of the filter[2]. The fluid portion is to be treated in the manner recommended for ascertaining the amount and relative proportions of the principal classes of ingredients entering into the composition of the urine, and for which see Willis on Urinary Diseases, p. 25.

To examine the nature of the deposits, let a known quantity of any of them be boiled with distilled water, by which any alkaline lithates will be dissolved. The solution being evaporated to dryness, a portion of the extract should have a few drops of nitric acid poured upon it; this will occasion the solution with effervescence of the lithic acid and the lithates. The nitric acid solution being dried by the application of gentle heat, the pink colour characteristic of the purpuric acid (formed by the action of the nitric on the lithic acid) will be evolved, and this tint will immediately pass into a bright purple on the addition of a little caustic ammonia. By this means we detect lithic acid. Another portion of the extract being mixed with some caustic lime, if it contains ammonia, this will be discovered by the smell, or by approaching a rod dipped in muriatic acid to the mixture. A third portion of the extract must be burned over the flame of a lamp in a platinum spoon, and the residue tested for alkaline reaction. The nature of the alkali found, whether potash, soda, or lime, is discovered by urging the residue for a moment with the flame of the blow-pipe. If it be soda the outer flame will be coloured yellow[3]. Potash and lime are distinguished by the solubility of the former in distilled water; or should the lime exist in the caustic state, when it forms an oxide of the base and becomes soluble, by passing a current of carbonic acid gas through the mixed solution, or adding a few drops of a solution of oxalic acid, it will immediately fall. The presence of the earthy salts—the ammonia-phosphate of magnesia, and the phosphate of lime, is known by the insolubility of the deposit in boiling distilled water, and by its ready solubility in dilute acids, from which the earthy bases are precipitated on the addition of an alkali. The relative proportion of the differently soluble lithates and the insoluble phosphates may be ascertained by digesting a known weight of the mixed precipitate in a sufficient quantity of attenuated caustic potash, or soda, which takes up the lithates, and leaves the earthy phosphates behind.

A recent great improvement in the analytic investigation of urinary deposits, introduced in the service of M. Rayer, and well described by M. Vigla[1], is the examination of these with the microscope. Some of the results of M. Vigla's investigations have already been given in the general view of the lithic deposits, and we shall have occasion in the course of this article to refer to others,

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[1] D'Arcet, in Ann. de Chimie, 1826.

[2] The following is the Receipt in the French Codex for the artificial Vichy water; Carb. of soda, 1 drachm, 56 grains; chloride of calcium, 11 grains; chloride of sodium, one-third of a grain; sulph. of soda, 6 grains; sulph. of magnesia, 3 grains; sulph. of iron, one-third of a grain; water, deprived of air, 20 oz.; carb. acid gas, 3 volumes and a half.

[1] Wetzlar, l. c. who found he could obtain a deposit of lithic acid by this means, in many cases where the simple addition of an acid failed to produce it.

[2] Prout, l. c. p. 126.

[3] Rees, l. cit. p. 74.

Sedimentary Urine in which the Deposit consists of the Earthy and Earthy-Alkaline Phosphates.—We have seen the existence of the lithic acid in a state of solution to be incompatible with the presence of a free acid in the urine. The earthy phosphates, on the other hand, and especially the phosphate of lime, are only held in solution by virtue of the excess of acid with which they are combined, or in consequence of the presence of some other free acid in the urine, which can in many cases be demonstrated to be the carbonic. The *neutral phosphate of lime*[2] is a salt to all intents and purposes insoluble. *Phosphate of magnesia*, another urinous salt, is not very soluble, requiring at least fifty times its weight of water to take it up. *Phosphate of ammonia*, indeed, is soluble enough by itself, but in combination with the phosphate of magnesia, as it always exists in urine, it become exceedingly insoluble. A slight excess of phosphoric acid, and, as it would appear, the presence of carbonic acid in some cases, put an end to the insoluble character of these salts; as superphosphates or carbo-phosphates they become readily soluble, and are safely carried out of the system.

Like the lithic sediments, those consisting of the phosphates occur either in the crystallized or amorphous state. In the former case the crystals are white and glistening, and their formation is frequently accompanied with the precipitation at the same time of a certain quantity of the amorphous lithic sediment. A condition of the renal secretion in which the lithic acid is deposited would not appear to be incompatible with a ruddy complexion, a feeling of high health, and such a state of the bodily functions as does not debar from indulging the animal appetites of hunger and thirst. There is here a state of *hypersthenia*, as the older pathologists would have called it; if there be aught amiss, it is merely some slight dryness of the lips, and rather more heat of skin than occurs with perfect health. When the phosphates are habitually deposited, however, the state of matters is widely different; even the mildest form of the phosphatic diathesis, that, namely, in which crystals of the triple phosphate of ammonia and magnesia are formed, is never seen among the robust and ruddy. It is constantly preceded and accompanied by such a degree of nervous irritability and general delicacy of health, combined in the vast majority of instances with so much disturbance of the digestive functions, that the appearance of an individual is mostly of itself a sufficient index of the form of urinary derangement under which he is labouring.

The phosphatic state of urine, when observed at an early period, is generally found to alternate with that in which the cream-coloured or pale-tawny amorphous lithic sediment occurs. By and by, however, and as the constitutional peculiarity with which it is associated becomes confirmed, the lithic deposits are observed more and more rarely; and, finally, when the constitution is completely broken up, they do not appear at all.

As might be presumed, the phosphatic diathesis presents different phases according to circumstances. When first induced in individuals of nervous temperament and delicate constitution, along with the low-toned symptoms of general disturbance, we observe more or less of uneasiness, rarely amounting to pain, in the back and lumbar region. The urine is invariably pale coloured when passed, and is as uniformly secreted in excess, so that there is almost always a certain degree of hyperuresis present as a distinct feature in the complaint. This urine is not uncommonly weakly acid when first voided; very frequently, however, it is neutral; and after the disorder has continued for some time, or is increasing in severity, it never fails to become alkaline. Its specific gravity varies greatly according to the period of the day when it is examined; the writer has found it as low as 1,004 in the early part of the day, and as high as 1,033 about eleven o'clock at night, the time when he has always found the urine to possess the highest density. This urine passes much more rapidly than the decidedly acid lithic urine into putrefaction, when it exhales a most offensive odour, and evolves an abundance of ammonia.

It rarely happens that crystals of the phosphates are deposited within the body; when they are, it is almost always in cases of renal derangement of some standing cases in which the kidneys and bladder are deeply implicated, and the urine, in consequence of this, is ammoniacal before it is discharged. It has, indeed, been made matter of doubt whether crystals of the phosphates were ever deposited within the pelvis of the kidney. Such an occurrence is undoubtedly rare, but it has happened; gravelly concretions, composed of the triple phosphate and of the phosphate of lime every now and then present themselves, and there are few extensive collections of calculi in which several will not be discovered having one of these for a nucleus. The phosphates, however, are just as commonly met with encrusting or forming the outer laminæ of urinary calculi, as they are rarely found composing their centres. When crystals of the ammonia-magnesian phosphate are discharged with the urine, they constitute what is called *white* sand, in contradistinction to *red* sand, which consists of the lithic acid.

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[1] L'Expérience, Nos. 12, 13, 26, and 27. Paris, 1837-38.

[2] Dr. Henry reckons the quantity of phosphate of lime contained in the urine at as much as half a grain to each ounce of the healthy fluid. Elem. of Chem. vol. ii.

Instead of showing themselves in the form of crystals, the phosphatic salts much more commonly occur as amorphous sediments, and with symptoms of a far more distressing character than have been described above. A phosphatic state of the urine, however, can hardly be regarded as an original and idiopathic malady: it is very uniformly the sequence and complement, as it were, either of some serious general constitutional disorder, or of a state of great irritation, often of structural disease of one or other of the urinary organs. We therefore find it occurring among the unhealthy, ill fed, and worse clothed children of poor, ignorant, and profligate parents; or otherwise, when the heyday of life is gone, and the system is feeling the effects of an accumulating load of years, of over-exertion whether of mind or body, and perchance of excesses committed in earlier life, circumstances by each and all of which it is often apparently induced.

Causes.—Local and accidental causes, however, seem in many cases to be intimately connected with the secretion of a urine that contains an excess of the phosphatic salts. Strains and injuries of the back, concussions, or more serious mischief to the spine from blows, falls, &c. have, in numerous instances, preceded and apparently caused this state of urine. Again, almost all the diseases of the external urinary organs which require manual interference, such as the introduction of catheters, bougies, &c.; irritable states of the bladder, induced by stricture in the urethra, enlarged prostate, the presence of a calculus or other solid foreign body within that cyst, are severally well known to be powerful causes inducing the kidney to secrete a urine that is overloaded with the phosphatic salts. These are points of great consequence to be borne in mind, a knowledge of which, indeed, is of paramount and primary importance to whosoever would duly understand and successfully treat this interesting class of complaints.

The habitual secretion of phosphatic urine is always accompanied with great irritability of system, and much disturbance of the general health. The functions of the stomach and bowels are deranged: the appetite not only fails, but there is often a positive loathing of food; the stomach is flatulent; the bowels are constipated or purged, the evacuations in either case being of the most offensive and unhealthy description. The patient complains of listlessness and depression, there is not only a singular disinclination but an absolute inability to make any exertion. This state of weakness is progressive: the flesh wastes, and the features assume a care-worn and haggard aspect. The mind, too, suffers; the patient almost invariably becomes morose and selfish, or peevish and discontented; his whole character is changed.

The urine under these circumstances is not only disordered in quality, but it is often secreted in excessive quantity. It is always pale-coloured, and if transparent when first voided, which, indeed, is rarely the case, it grows turbid as it cools, and lets fall an abundant precipitate of a white impalpable powder, consisting of the combined phosphates of ammonia and magnesia, and phosphate of lime. If brought to the boiling point, a flocculent deposit takes place, which has often been mistaken for albumen, but which consists principally of the phosphate of lime, as is immediately made manifest by the addition of a few drops of nitric acid, which re-dissolves the precipitate and restores or gives complete transparency to the liquid. On standing, phosphatic urine hardly ever becomes perfectly transparent. Even within a few hours it is covered on the surface with a delicate pellicle, which is often iridescent, and on the lower aspect of which well-shaped crystals of the triple phosphate of magnesia and ammonia are rapidly formed and sink through the fluid when it is disturbed, or when they become so heavy as to break away from the film. The urine becomes ammoniacal, and then the deposit goes on still more rapidly than before. Sometimes it is alkaline even at the moment it is voided; in any case, and when the temperature is between 50° and 70° Fahrenheit, it is not long before it begins to putrefy, and to evolve ammonia in abundance.

This is another among the many disordered states of the urinous secretion, which will be found spoken of by writers under the title of *Diabetes*, with the epithet *chylosus*. The case of the old man of 70, mentioned by J. P. Frank[1], who, after having carried a heavy burthen, began to complain of pain in his loins, and to pass large quantities of milky-looking urine, would probably be rightly referred to the class of cases we are considering. The milky look of the phosphatic urine at the time it is voided in some cases, and the fact of its letting fall a flocculent precipitate, when exposed to the boiling temperature, are circumstances which have often led to the supposition that it contained albumen. The mistake is at once detected by adding a drop of the muriatic or nitric acid, by which the precipitate is immediately dissolved, and the fluid rendered completely transparent.

Treatment.—In undertaking the treatment of that disturbed state of the constitution which is accompanied by the secretion of phosphatic urine, particular attention must be given to the circumstances connected with which it exists, or by the agency of which it has been engendered. If the phosphatic urine be seen but as one among a host of symptoms denoting general constitutional disturbance, it must be met generally; if it be obviously an effect of some peculiar local irritation, it will require to be attacked on the side whence it comes. In every case an endeavour must be made to restore the tone of the system at large, which will be found constantly to have suffered in a greater or less degree; whilst the irritable state of the kidneys and urinary passages, that invariably forms so marked a feature in the disease, must be allayed, and each particular cause of disturbance connected with these removed as speedily as circumstances will permit.

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[1] Epitome de Curand. Hom. Morbis, tom. i.

The state of the stomach is an object of the highest importance. The regulation of the diet must precede and be made paramount to all kinds of medicinal means. Both the appetite and the powers of digestion are almost always in the same degree impaired, so that the patient is here little inclined to commit errors of excess; he must be no less particular in the matter of quality. The food must be of the lightest and most nutritious kind, qualities that are happily combined in farinaceous articles prepared with milk. Where these agree they seem to supply as bland and congenial nutriment to the shattered frame as can be devised. Most of the white fishes, as whiting, haddock, sole, and turbot, eaten in great moderation, are generally found easy of digestion. The white meats supplied by the poultry yard roasted, broiled, or boiled, are commonly recommended; they do not always agree so well, however, as some of the darker kinds of meat. The flesh of a chicken will sometimes cause flatulence, and become acescent on a stomach that will digest perfectly a small quantity of tender mutton of full age, well roasted or nicely broiled. There is no kind of food which gives such a feeling of renewed strength to a patient who has suffered from an irritable state of system, and the secretion of urine superabounding in the phosphates, as a slice of roast or broiled mutton. A pullet's egg softly boiled is among the most digestible, and also one of the most nourishing articles of human food. Made into pudding by long baking or boiling, it becomes however extremely indigestible. Cocoa lightly made and free from oil is the best diluent at breakfast. Tea is always pernicious in irritable conditions of the system, and ought to be entirely renounced. Large quantities of fluid of any kind, indeed, are to be avoided in those states that are accompanied with deposition of the phosphates; the kidney is already in a state of erethism; it is inclined to do too much, and is not likely to be quieted by having any thing like heavy duty thrown upon it. Instead of the lighter French and Rhenish wines, which have been recommended by very high authority in this form of malady, but which are objectionable, as having a decided tendency towards the kidneys, and often a positive influence in augmenting the alkalescence of the urine, a glass or two of old dry sherry, diluted with half as much or an equal quantity of water, will be found far preferable[1]. The lighter wines with a full bouquet never fail to disagree with weak stomachs; there is something peculiarly indigestible in the principle on which the odour and flavour of these wines depend.

With regard to medicine, the bowels, which are so commonly sluggish and disordered, require to be kept gently open. One comfortable evacuation in the course of the four and twenty hours is just as indispensable as purging is pernicious. Rhubarb and aloes combined; rhubarb and senna, or castor oil in nicely adjusted doses by the mouth, and if need be an occasional glyster of tepid water to aid nature, will generally be found to answer the end of maintaining an open state of bowels. Saline medicines of any kind are objectionable in the phosphatic diathesis. When the combining acid is of vegetable origin, the salt is decomposed, in part at least, in the stomach, and the base passes by the kidney, increasing the alkaline state of the urine; when of mineral origin, the compound excites watery discharges by the bowels, which lower the patient and make matters worse.

With due attention to every circumstance, by far the most valuable medicines we possess in that state of the system which is accompanied with the too copious elaboration and deposition of the phosphates, is opium. It is, indeed, in these cases, worth all the rest of the materia medica, and may be used with an assurance of answering expectation, if it be but exhibited in such doses as will ensure its full effect, and this effect be kept up by repetition at regular intervals. There is probably no better form for prescription than the drug in its natural state, or in the shape of the watery extract made into a pill. The common tincture of the Pharmacopœia with the addition of a few drops of muriatic acid, may be selected if the liquid form be preferred. The recently introduced salts of morphia (especially the chloride and the meconate) are also greatly to be commended. Far from destroying the appetite, and enfeebling the digestion, opium, or a salt of morphia, prescribed in the cases which are distinguished by the elaboration of phosphatic urine, will often be found to increase both the relish for food and the powers of the stomach to digest it; a fact which admits of easy explanation.

When we have succeeded in quieting the excessive irritability of the system by opiates, and provided in some sort against its recurrence and continuance by the regulation of the diet, open bowels, &c., we may begin the use of such general tonics as the bark, calumbo, gentian, &c., the preparations of iron, and the mineral acids. With these may be very advantageously combined some one or other of the articles which experience has shown to possess a kind of specific influence in allaying irritability of the urinary organs, particularly the uva ursi, pareira brava, alchemilla arvensis. An extract of the uva ursi, combined with extract of hyoscyamus or opium, according to circumstances, has been strongly recommended on high authority. The ferrum sesquichloridum, of the last London Pharmacopœia, or its tincture, is an excellent chalybeate; and when the phosphatic diathesis can be obviously referred to affections of the urethra, prostate, or bladder, the ferrum ammonio-chloridum, or its tincture, may be substituted, and will be found an invaluable medicine.

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[1] After some attention to this subject, which peculiar circumstances have afforded the writer opportunities of paying, he ventures particularly to recommend the fine Spanish wine called Amontillado. This, and the other carefully made wines, which are the produce of the vineyards of Xeres, in especial of those which are the property of the Domecq family, may be depended on, and are the proper cordials for invalids, whenever this class of medicines is admissible.

As a means of securing all the benefit to be derived from medicinal treatment of any kind, the patient should, as speedily as possible, escape from the atmosphere of a populous city, and the depressing influence of confinement in the midst of a town. Removal to the country has often of itself the happiest influence in restoring vigour to the shattered frame. Gentle exercise should also be attempted at as early a period as is consistent with prudence.

Among the many interesting discoveries due to the continual advances of modern chemistry, is the fact, that by peculiar treatment many long series of organic elements may be converted one into another. The first step has even been made in forming some of these by the direct combination of their constituent or ultimate elements. Urea, for instance, the highly azotized and distinguishing proximate principle of the urine, has actually been formed synthetically by the celebrated German chemist Woehler.

If we set out from this peculiar organic principle, the ultimate composition of which appears to be 46,65 nitrogen, 19,97 carbon, 6,65 hydrogen, and 26,65 oxygen, ($N^2\ C^2\ H^4\ O^2$,) and suppose the proportions of nitrogen and hydrogen to be lessened, whilst those of carbon and oxygen are increased, we shall have lithic or uric acid produced ($N^4\, C^5\, H^4\, O^3$). Again, if we suppose the nitrogen, carbon, and hydrogen, to remain as in lithic acid, but the quantity of oxygen to be diminished to the extent of one atom, we shall have the lithic or uric oxide (xanthic oxide Marcet, produced —($N^4\ C^5\ H^4\ O^2$). Farther, if the nitrogen and carbon fall short, whilst the hydrogen and oxygen increase in relative quantity, we have another element of morbid urine formed, namely, cystine, or cystic oxide, of Wollaston, ($N^2\ C^3\ H^6\ O^4$.) Another very remarkable quaternary compound, occasionally met with in morbid urine, is carbonate of ammonia, for the presence of which we should, without the lights afforded us by chemistry, be greatly at a loss to account. But when we know that the elementary composition of urea is identical with that of the cyanate of ammonia; that if one atom of this substance and one atom of water come to decompose each other, which readily happens, and that the product is exactly one atom of *carbonate of ammonia*, we have no difficulty whatever in explaining the occurrence in the urine of the volatile alkali combined with carbonic acid.

Occasionally, again, two of the elements of urea part company, as it were, with the other two, and enter into certain binary combinations that are also now and then detected in the urine, either alone, or accidentally conjoined with bases which they have encountered in the fluid. Thus the nitrogen and carbon uniting and separating themselves from the hydrogen and oxygen, give rise to *cyanogen* or bicarburet of nitrogen; and it is no less remarkable than indisputable that compounds of the cyanic acid, other than the cyanate of ammonia already mentioned, such as the *ferrocyanate of potash*, and even *hydrocyanic acid* in a free state, are sometimes met with in the urine. It farther happens not uncommonly, especially in certain febrile states of the system, that the nitrogen and oxygen select each other peculiarly, leaving out of the question the carbon and hydrogen, and form *nitric acid*, which, acting on the lithic acid, has been held the source of the compounds that are described under the titles of the erythric and purpuric acids. Finally, if the nitrogen and hydrogen part company with the carbon and oxygen, and leave these last to unite very nearly in the proportions in which the former occurs in lithic acid, the latter in cystine, we have *oxalic acid* produced,—39,99 carbon, 53,33 oxygen,—an occasional and very formidable constituent of the urine in certain morbid states.

Under other circumstances, the kidney seems to fall short of the acidifying property it possesses as part of its distinguishing function, and then the radicals of the acids which the urine contains present themselves in an uncombined state. It is in this way, probably, that phosphorus now and then appears in solution in the urine, so that the fluid is seen to be luminous when emitted in the dark.

A certain number only of these combinations interest us in connection with the subject of calculus, and these we shall now proceed to discuss in succession.

Elaboration of Urine, containing the Lithic Oxide.—The existence of the calculus described by Dr. Marcet, under the name of the *xanthic oxide* calculus, was, in some sort, called in question by Berzelius[1], who insinuates that in all probability it was nothing more than uric acid modified by accidental admixture. The accuracy of our late distinguished countryman, and his discrimination in separating from other calculi the one he described as consisting of xanthic oxide, have, however, been fully confirmed by some very recent researches of Liebig and Woehler[2]. It was known that Professor Langenbeck, of Goettingen, had extracted a stone of this substance, the chemical nature of which had been either investigated imperfectly, or else had not been made known by Stromeyer, who had also examined it. The calculus, or rather the three-fourths of it which still remained, were at once, on a request to that effect, placed by Professor Langenbeck at the disposal of the eminent chemists named. They found its chemical history to correspond in every particular with the account given by Marcet, and by a very beautiful elementary analysis showed, that the constitution of the xanthic oxide was the same as that of lithic acid *minus one atom of oxygen;* that these two substances were in fact two oxides of the same radical, the formula of lithic acid being $C^5 N^4 H^4 O^3$, that of the xanthic oxide, which they of course designate with the greatest propriety lithic or uric oxide, being $C^5 N^4 H^4 O^2$.

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[1] Chimie, par Esslinger, tom. vii. p. 427.

[2] Poggendorff's Annalen. Bd. 41, 1836.

We are not aware that the uric or lithic oxide has ever been distinguished either in solution or as a deposit from the urine; but if we have concretions of this substance formed in the kidney, undoubtedly we shall also, with due attention, detect it in the shape of a sediment in the urine; and the subject is mentioned here in order that attention may be drawn to the point.

The lithic oxide may be expected to occur associated with deposits of the lithic acid. We have, in fact, but to suppose the kidney to fall somewhat short of its acidifying powers, to have the lithic oxide instead of the lithic acid (the *oxide* instead of the *acid* of urea) produced.

Elaboration of Urine which contains Cystine (cystic oxide) in solution or as a deposit.—The peculiar substance discovered and described by Dr. Wollaston as occasionally constituting urinary concretions, under the name of Cystic Oxide, has been several times discovered in urine, in a state both of solution and mechanical suspension. Dr. Prout found the urine, in a case in which the formation of a cystic oxide calculus was going on to be secreted rather copiously, to have a specific gravity of from 1.020 to 1.022, and to exhibit a yellowish-green colour. It was faintly acid, and contained very little lithic acid and urea. Its surface by standing became covered with a greasy-looking film, which was cystic oxide. A copious pale precipitate was thrown down by the bicarbonate of ammonia, consisting of cystine and the ammoniaco-magnesian phosphate. In a case met with by Dr. Venables[1], in which renal calculi of cystic oxide had been passed, the urine, voided in medium quantity, was of a greenish-yellow colour, and had a slightly saline taste. Its smell was very peculiar, like that of the sweet-briar mingled with a fetid urinous odour. It slightly reddened litmus. Its specific gravity was 1.022. It had an oily consistency, and was slightly turbid from holding an impalpable powder in suspension. The writer, also, detected this substance in a case in which there never had been any renal concretion passed, nor was there reason to suspect that any existed. His attention was arrested by the greenish-yellow colour of the urine, its peculiar smell, and its somewhat oily appearance when passed. It reddened litmus paper very slightly, if at all; was of sp. gravity 1.030; did not coagulate by heat or nitric acid, and by standing became opalescent after thirty-six hours, from the presence of a fine pulverulent matter, part of which was deposited. Acetic acid threw down a pretty copious brown precipitate, which, collected on a filter, was found to possess all the properties of cystine. This urine held a considerable quantity of the phosphatic salts in solution, which seems common; it showed no traces of lithic acid; but was not deficient in urea; although the three writers who have given any account of a urine in which cystine was contained, are agreed that the specimens they examined were deficient both in urea and lithic acid[1]. The best re-agents for discovering cystine in combination with alkalis are the acetic, citric, or tartaric acid; in each of which it is insoluble. The bicarbonate of ammonia immediately throws it down from its soluble combinations with potash and soda.

Elaboration of Urine, which contains the purpuric acid and its salts.—When nitric acid, diluted with five or six times its weight of water, is poured upon a quantity of pure lithic acid, and heat is applied, the lithic acid is dissolved with effervescence, and if it be in excess, nearly the whole of the nitric acid is decomposed, with the evolution of equal volumes of carbonic acid and azotic gas. The solution when examined is found to contain a new acid, described by Brugnatelli[2] under the name of erythric acid, and by Prout[3], who investigated its qualities particularly, and determined its elementary composition, under that of purpuric acid, from the fine purple colour which its alkaline and some of its earthly salts possess.

The processes which take place in our laboratories appear occasionally to occur in the kidney. This, at least, was Dr. Prout's opinion; for he detected nitric acid in the urine, in certain febrile states, and he ascribed the red colour of the sediments of febrile urine, and the pink hue of the sediment of hectic and dyspeptic urine, principally to the presence of a purpurate, generally the purpurate of ammonia, occasionally the purpurate of soda. The accuracy of this view of Prout was some time back called in question by Vogel, then by Frommherz and Gugert, and finally by Berzelius, who concluded from his experiments, that the red and pink colours of urinary sediments were not caused by the intermixture of a purpurate of any base, but by the presence either of the ordinary colouring matter of the urine, or of a peculiar animal matter, which dyed the deposits in the manner of lakes[1]. This conclusion has been verified to their own satisfaction, by the Messrs. Brett and Bird[2], who found pink urinary sediments in several cases to consist of the lithates of ammonia, soda, and lime, free lithic acid, and a trace of the earthy phosphates, tinted by a peculiar colouring matter, which differed in many essential particulars from purpuric acid, or any of the alkaline purpurates. Messrs. Vigla and Quevenne[3], again found the "rose-coloured sediment of an acid urine" to consist almost entirely of lithic acid, with a little animal matter, probably of the nature of mucus, (the peculiar colouring matter,) some phosphate of lime, and some soda, which was undoubtedly united in the first instance with the lithic acid. Organic chemistry forms the Low-Countries of the science,—the proper theatre of difference and dispute.

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[1] Journal of Science and the Arts, vol. xxix. Jan. 1830.

[1] Vide Stromeyer in Ann. of Philos. N. S. vol. viii. p. 146; Prout, Inquiry, p. 166; Venables' Journal of Science and Art, Jan. 1830.

[2] Giornale di Fisica, &c. tom. xi. p. 177.

[3] Philos. Trans. 1818, p. 420, and Med. Chir. Trans. vol. ix.

Treatment.—With regard to the treatment of those states in which the urine lets fall rose-coloured sediments, or continues of a fine pink hue without depositing, little need be said. The indications of cure are general and particular. In *general*, when the accompanying symptoms are those of febrile excitement, our attention must be mainly directed to these. When they have the character which we observe in the lithic diathesis, our plan of treatment would be adopted in harmony with the views exposed in the section on that subject; the diet would be regulated, the food being made to consist of farinaceous articles, and meats of easy digestion; and the bowels would be freely opened with a dose of calomel and rhubarb, followed up by a neutral salt in infusion of senna. An alterative dose of blue pill or Plummer's pill might be prescribed at intervals, and febrile excitement allayed, and the renal secretion improved by the daily use of the neutral citrate of potash with a very minute addition of tartrate of antimony. To the saline medicine the tincture of hyoscyamus is sometimes added with advantage in irritable systems; but this medicine is often observed to produce more dryness of tongue, and for its sedative effects to be followed by a higher degree of subsequent fever, than are induced in many cases even by opium. Anodynes, as a general rule, are not to be insisted on.

In *particular*, it must be our business to discover whether any and which of the viscera or internal organs suffer, and also to distinguish the nature of the individual affection, to which appropriate treatment should of course be directed. The glandular system especially must be narrowly looked to, and its functions where faulty set to rights, or the attempt at least made to do so. When the digestive functions are disordered, our sheet-anchor will be regulated diet, proper exercise, and country air. Violent medicine of every kind will do mischief.

The elaboration of a peculiar pink colouring matter would not appear to be connected with a state of things necessarily formidable in itself; so that when we have secured the proper performance of the various abdominal functions, we have probably done all that is really important in the case. The formation of pink-coloured lithic deposits should, however, always be held worthy of particular attention; we have observed at least one instance in which a deposit of this kind appeared to form the nucleus of a stone in the bladder, and there is a figure extant of another[1]. Every state of urine that is liable to be followed by such a disease as calculus cannot be held of too much importance.

Elaboration of Urine which contains a Salt of the Oxalic acid.—Lithic acid, under the prolonged action of nitric acid and of chlorine, is partly converted into oxalic acid; and Liebig and Woehler found, that when lithic acid was boiled with the superoxide of lead it was resolved into urea, alantoin, carbonic acid, and oxalic acid. Besides, it has been shown in the general remarks that immediately precede, that the proportion of carbon which exists in lithic acid, united to the proportion of oxygen which occurs in cystine, form as nearly as may be the combining quantities of the elements of oxalic acid. There would not therefore appear to be any peculiar difficulty in accounting for the occasional existence of oxalic acid as a product of the renal secretion. It does not seem necessary to suppose that this substance should be introduced among the ingesta: its elements exist in urine, and the chemic power of the kidney may, and undoubtedly does, suffice at times to combine them into the compound in question. Nevertheless, it remains true that certain articles of food, which are pretty generally used in some countries, contain oxalic acid; and the experiments of Woehler[2] have put it beyond doubt that it is one of the few acids that make their way into the torrent of the circulation, and are then eliminated both free and combined with a base from the system by the kidney. The urine contained in the bladder of a dog, killed eight hours after having had two drams of oxalic acid mixed with a quantity of meat and bread given to it, was found to deposit a precipitate on cooling, which bore an exact resemblance to that formed by the triple phosphate. The clear urine mixed with a little of a solution of nitrate of lime gave a farther deposit, having the same external characters. On examination, both of the deposits were found to consist of oxalate of lime. The articles of food used by man which contain oxalic acid in largest quantity are the sorrel, (Rumex acetosa,) so much eaten by all classes in France, and consumed to some extent by the upper ranks in England as an agreeable vegetable; the tomata, (Solanum lycopersicum,) of which many individuals are passionately fond; and the leaf-stalk of the rhubarb plant, (Rheum palmatum,) which in the spring and early summer months is consumed in large quantities made into pies and puddings by the community at large in England.

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[1] Chimie, par Esslinger, tom. vii.
[2] Lond. Med. Gaz. vol. xiv. p. 600.
[3] L'Expérience, No. 13.

[1] In Brugnatelli Litologia Umana, No. XXXIV.
[2] Uebergang von Materien in den Harn, in Zeitsch. für Physiol. B. 1, S. 139.

It is only lately that we have any accurate knowledge of the oxalate of lime occurring as a deposit from the urine. Dr. Prout, indeed, mentions one case in which he had observed this salt to be precipitated from the urine[1]; but for the most complete account we have of this circumstance, we are indebted to Mr. Henry Brett, who, among his excellent observations on urinary deposits, contained in the seventeenth volume of the London Medical Gazette, has published the particulars of the case in which it occurred. The subject of observation was a man 35 years of age, who had been employed of late in sedentary occupations. Somewhat more than twelve years before, he had attempted to raise a heavy weight in each hand in a constrained position, and had felt something give way in his loins, and then passed bloody urine for several months. Up to the time of observation, he continued subject, upon making any particular exertion, to a discharge of bloody mucus in his urine, mixed with an amorphous deposit. In November, 1835, he had these symptoms in an unusually violent degree, attended with extreme pain in the lumbar region, but none in the course of the ureters. The urine at this time was of a dark reddish brown colour, and opaque; its specific gravity was remarkably high, 1.060, and it showed an acid re-action which it did not lose for several days. Left at rest for twenty hours, it let fall a deposit of a greyish brown colour, the supernatant liquid still continuing somewhat turbid. Filtered, the fluid that passed through was of a rich claret colour, and perfectly transparent. The insoluble part detained by the filter after being repeatedly washed was still of a greyish brown colour. It dissolved readily in dilute nitric acid assisted by heat, the solution giving no indication of lithic acid or a lithate. Incinerated, it became blackened and passed rapidly into bulky white ash, which was soluble in muriatic acid with disengagement of carbonic acid. This acid solution boiled and then treated with an excess of ammonia remained clear; a little oxalate of ammonia, however, instantly caused a copious precipitate. The clear fluid was found to contain some albumen, freed from which by boiling and filtration it did not differ from healthy urine in colour.

Unquestionably deposits of the oxalate of lime will be found to occur much more frequently than they have yet been imagined to do, when the urine comes to be more a matter of enlightened attention than it is at present, and when the members of the profession at large think it worth while to call up the few chemical principles, and the small share of manual dexterity required to examine the urine of their patients for themselves. Unmingled with other substances, as in the case just referred to, a deposit of oxalate of lime from the urine is probably a rare occurrence; there can be little doubt, however, but that a portion of oxalate of lime frequently occurs among the number of heterogeneous matters comprised in amorphous urinary sediments. Most of those who have been in the habit of examining the nature of these deposits chemically, have detected it from time to time, in company especially with the amorphous lithic acid sediment; though it would appear to have been frequently confounded with the lithate of lime, from which it may always be distinguished by its complete insolubility in boiling water, which takes up the lithate of lime readily.

The circumstances that may be supposed likely to lead to the state of urine in which the oxalic acid is thrown down in combination with an earthy base, and that consisting of lime, are in all probability intimately connected with those which lead to the deposition of lithic acid.

The medical *treatment*, in such a state of things, would be conducted on the same general principles which guide us in treating the lithic diathesis. The antiphlogistic regimen in moderation, alterative doses of chloride of mercury or of blue pill, occasional aperients, in which a neutral purgative salt of a vegetable acid formed an ingredient, and a course of the alkaline bicarbonates, continued for some time, would be the proper medicines. Should an oxalic deposit from the urine be observed to take place whilst any of the vegetables which contain oxalic acid was habitually used as food, it would of course be imperative on the party whose urine presented the peculiarity in question, to give up that article immediately.

RENAL AND VESICAL CALCULI.

We now proceed to examine the phenomena that accompany the deposition of one or other of these little-soluble substances in some point in the course of the uropoetic organs, the consequences of the presence of the foreign bodies thus engendered, and the means we possess of removing them from the system.

Renal calculi of the lithic acid.—In speaking particularly of the different kinds of sedimentary urine, it has been stated that the deposit was liable to take place as well within the body as without. The situation in which this internal deposition takes place, may be said (except in those cases in which foreign bodies are introduced into the bladder) to be all but invariably the body and pelvis of the kidney. The natural nuclei of urinary calculi of every description are engendered in the kidney, and were there not something wrong at the moment the urine is generated, we should never have a nucleus. In aggravated cases of the lithic diathesis, crystalline particles of the lithic acid or one of its salts may frequently be pressed out of the tubuli, or radiated tissue of the kidney, and aggregations of these particles are occasionally observed clogging up the tubuli; so that it is not merely in the pelvis or receptacle, but in the substance of the kidney itself that the deposition of solid matter takes place.

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[1] Inquiry, p. 153.

Gravel is the term applied to urinary concretions of small size, that are passed from the kidney into the bladder, and thence expelled within a brief period. Such concretions present great varieties; only two of them, however, are at all common; those of the lithic acid and of the triple phosphate; and of these the lithic acid are out of all proportion the most frequent; in fact, if we were to exclude some particular districts in which the oxalate of lime concretion is common, as around Bristol and Wuerzburg, about nineteen in twenty cases of gravel would be found to consist of the lithic acid kind. As of by far the most frequent occurrence then, and consequently of much the most importance, let us briefly review the circumstances attending an attack of lithic acid gravel, the circumstances preceding which have been already detailed.

Symptoms.—It is a remarkable circumstance, but one which had frequently been observed, that just before unequivocal evidence is afforded of the deposition of calculous matter within the kidney, the urine which had long been observed to deposit freely, ceases to let fall any sediment as it cools. Instead of this outward symptom of deranged renal function, the urine is secreted in diminished quantity, and even higher coloured than heretofore, and symptoms of general constitutional disturbance also make their appearance:—the appetite fails, the tongue is furred, the bowels are constipated, the skin is hot and parched, the pulse is increased in force and frequency, there is restlessness, head-ache, thirst, &c.,—in a word, the symptoms of simple fever are developed.

After a day or two, gritty particles very commonly make their appearance in the urine. As they come away, these are apt to excite sharp scalding pains, higher or lower in the course of the urinary passages. So long as they remain lodged in the pelvis of the kidney, indeed, they occasion little uneasiness beyond a sense of weight; but the moment they have fairly entered the ureter, if they are of any size, the pain they excite often acquires a character of great intensity, so that a strong man in a paroxysm of *nephritic colic*, or *calculus making its way down the ureter*, generally becomes helpless as a child; he quivers with agony, big drops of sweat burst from his forehead, he becomes sick, and the contents of his stomach are discharged by vomiting. The pain from the part more particularly affected shoots at intervals, like a cramp, down into the bladder and groin, along the penis and front of the thigh, and the testis of the affected side is retracted towards the inguinal ring. During the fit there is farther a frequent desire to make water, which is always accomplished with difficulty, and with a severe extension of the pain to the extremity of the member. By and by the urine is very commonly tinged with blood; and when this occurs to any extent, small coagula, or fibrinous clots, are voided with gritty particles adhering to their surface. These symptoms continue with remissions and exacerbations more or less marked, for a variable length of time; sometimes they are relieved suddenly, at other times they die away by degrees. The most favourable termination of the fit is when a quantity of gritty particles, or one or more concretions, are voided with the urine.

The symptoms attending the generation, and especially those accompanying the passage to the urinary bladder of gravel or renal calculi generally, do not differ in any material respect from those which have now been described as marking the formation and progress of a concretion of lithic acid. But the different circumstances under which various concretions belonging to each of the two great classes into which all depositions from the urine may be divided, necessarily impress considerable variety on the kind of treatment adapted to these.

In the one class the writer would arrange concretions of the lithic acid and the lithates, of the oxalates, of cystine or cystic oxide, and of the uric or xanthic oxide; in the other, he would place the calculi formed by the phosphates. The state of system connected with which the whole of the calculi included in the first of these classes are engendered, has much in common; and though certain parts of the treatment especially adapted to the occurrence of lithic concretions, may prove of less avail in those cases in which the oxalates and animal oxides are deposited, still they will not prove prejudicial, and may even do as much good as any plan that can be followed. In those cases in which the phosphates are deposited, however, matters are different, and the treatment requires in almost every particular to be different.

Treatment.—In treating a fit of renal calculus rationally, it is therefore imperative on us to have an eye to the circumstances that have preceded the attack, and to make sure of the conditions and qualities of the urine that are associated with it. Supposing the lithic acid and the lithates to have been for some time habitually deposited, and to be still precipitated during the fit, we have several clear indications of treatment before us, happily for the most part of easy accomplishment. These are, First, to lessen the quantity of the lithic acid elaborated by the kidney; Second, to increase the dissolving powers of the urine by adding to its quantity; Third, to augment the solubility of the lithic acid as it is formed by securing its combination with an alkaline base; and Fourth, to attempt the expulsion and solution of the concretions or calculi already formed.

I. The most effectual means of lessening the quantity of lithic acid formed by the kidney is to diminish the semifebrile or hypersthenic state of the system with which it is so intimately connected, by abstracting largely from the amount of nutritious and stimulating food consumed. The patient must be put upon an *antiphlogistic* regimen, as it is termed ; his diet must be strictly regulated ; animal food in very moderate quantity must be allowed but once a day ; a single glass of sound wine, where the party affected habitually uses wine, largely diluted with water, must be substituted for the usual dose of generous Sherry or Madeira and old Port ; in a word, from having lived luxuriously, he who is attacked with gravel must begin to live abstemiously first, and temperately ever afterwards.

The most powerful direct medicinal means we possess of checking the formation of lithic acid is the exhibition of purgative medicines. And here the class of purgatives which experience has shown to be peculiarly adapted to inflammatory complaints will be found to exert the most beneficial influence. A dose of calomel and antimonial powder ought to be prescribed at night, and the common senna draught with soda tartarizata early in the morning, either every day or every other day according to circumstances at first, and regularly once if not twice a week for some time to come afterwards. The usual saline mixture, containing the citrate of potash or soda, with small doses of the tartrate of antimony and ipecacuanha, is also a very useful medicine.

II.—*To increase the powers of the urine to hold in solution the lithic acid elaborated.*—The means most obviously within our reach of accomplishing this indication, is to add to the quantity of the solvent menstruum, and this end is readily effected by the free use of diluents. Let the patient, therefore, who is attacked with lithic gravel, whilst he eats less, drink considerably more than usual of any of the mild diluents so commonly prescribed to patients labouring under febrile and inflammatory complaints, such as toast-water, barley-water, rice-water, decoction of linseed, quince-seed, &c. M. Magendie has warned us against the use of diluents taken warm, as they then tend to pass off by the skin, and the urine is left more than usually concentrated. This caution is probably given on purely speculative grounds. On the contrary, to maintain a perspirable state of the skin is a great element in the successful treatment of calculous disorders generally. The urine is not diminished in quantity under the use of diluents taken of a temperature calculated to excite gentle diaphoresis nearly in the ratio in which its colour is deepened ; and the researches of Dr. Duvernoy, of Stuttgardt, already referred to, would lead to the conclusion that this state of urine was that precisely which it should be our endeavour to create, he having shown that the colouring principle of the urine was the element upon which the solubility of the lithic acid and super-lithate of ammonia mainly depends. Within the tropics, where the human skin is an open sponge, calculus is a disease almost unknown.

III.—*To increase the solubility of the lithic acid.*—The very sparing solubility of the acid has been already noticed. And the accomplishment of this indication must be attempted in a great measure through the agency of the first and second,—we must use means to secure that as little lithic acid as possible be elaborated, and furnish that which is formed with such a quantity of its natural solvent and watery menstruum as shall be adequate to hold it fluid. Happily we can do more than this ; we can guard against the decomposition and consequent annihilation of the proper office of the odorous and colouring matter of the urine —the *urodmechrome*, as it might be called, which in the generality of cases happens through the agency of some free acid in the urine, be this the natural lactic or phosphoric acid, or an adventitious acid such as the nitric, and perhaps the hydrochloric. This important object is to be obtained by neutralizing any free acid which the urine may contain ; and farther, by presenting the lithic acid with a base, by combining with which it may become more soluble than it is when free. The alkalis and alkaline earths fortunately accomplish both of these points in the most satisfactory manner. The alkalis especially are among the number of substances which find their way readily into the urine, and when used with discretion they are nowise prejudicial to the general health.

It is now upon the eve of a century since the Parliament of England purchased for a considerable sum of money from Mrs. Joanna Stephens her secret remedy for gravel and stone. This in the first instance consisted of calcined egg-shells, *i.e.* lime ; and afterwards of this substance in combination with soap ; in other words, a mixture of carbonate and hydrate of calcium and of margarate of soda, which last from its facility of decomposition may be viewed as equivalent to a compound of grease and the mineral alkali. This medicine long enjoyed an extensive and merited celebrity ; many men distinguished in their day bore testimony to its good effects, and its active ingredients are still those upon which we place considerable dependence in the treatment of calculous complaints. The *lime-water* and *bicarbonate of soda* which we now so commonly and often so successfully prescribe are nothing more than the *calcined egg-shells* and *Spanish-soap* of this so called specific in another shape ; whilst they are not less efficient in their operation, however, they are much more elegant as medicines, and far less offensive to the stomach.

Among the first cases recorded of the systematic treatment of gravel by the simple alkaline carbonate is that of the celebrated anatomist Mascagni, the particulars of which he has himself recorded in a very interesting memoir[1]. Mascagni suffered habitually from gravel. He had heard of the benefit which gravelly subjects derive from the use of Seltzer water, or aqua mephetica alkalina, one of the principal saline ingredients of which is bi-carbonate of soda. This water he tried, and found benefit from it. It seems to have struck Mascagni that he might improve upon the mineral water by taking its active saline matter or a matter of the same nature in larger quantity. Accordingly, on experiencing another attack in 1799, during which he voided concretions of considerable size, he put himself upon a course of carbonate of potash, beginning with a dram dissolved in half a pint of water the first day, and increasing the dose till he took three drams dissolved in a pint of water, a quantity which he continued regularly for ten days. The urine was strongly acid when this treatment was begun; the second day it had undergone very little change, but on the third, it was neutral. The pain in the kidneys now declined in violence, and no more grit or gravel was passed. By and by the pain ceased entirely, the urine appeared less loaded, and the alkali was recognized in it in excess. The medicine was now suspended, and several months elapsed before any farther symptoms of gravel were felt. On their recurrence on different occasions subsequently, Mascagni always resorted to his old remedy, and always with success. The fits gradually became more and more remote, and at the time of his writing, two years had elapsed without one having been experienced, though no carbonate of potash had been taken in all that time.

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[1] Published in the 9th vol. of the Mem. della Societa Italiana.

So remarkable a case as this, related by so remarkable a man, ought to have arrested attention more than it seems to have done; but it was just about this time that chemistry successfully investigated the nature of calculous concretions, and the most common of all being found very readily soluble in the *caustic* alkalis, these medicines began to be exhibited in this shape, in which they are both extremely disgusting to the palate, and from their acrimony hardly to be taken in quantity enough to accomplish the object of their exhibition. Numerous failures and much disappointment ensued, and the alkalis very undeservedly fell into discredit as remedies in numerous forms of calculous complaint. The pure or caustic alkalis, even supposing they were neither distasteful nor acrimonious, have in fact no advantage in their action on lithic concretions over the bicarbonates which are now generally employed with undoubted success.

In prescribing the bicarbonate of potash or soda, it is of great moment that they be exhibited in a state of very plentiful dilution. It is this condition much more than the quantity of the salts taken that secures their efficiency. Equal quantities of some of the natural mineral waters that actually contain but one or less than one part of bicarbonate of soda in 200 of the fluid, are more potent in rendering the urine alkaline than a solution of the same salt in the ratio of one to fifty or sixty. A drachm, or at most two drachms of the salt in from a pint and a half to three pints of fluid, is the proper proportion; and this quantity may be taken at intervals in the course of the day, with the effect of powerfully increasing the activity of the kidneys, speedily putting an end to the acid state of the urine, and either washing out lithic grit and concretions of late formation from the pelvis of the kidney, from the ureter or bladder, or disintegrating and dissolving them, wherever they chance to be arrested. Should the urine not become neutral in the course of a day, the quantity of the alkali may be increased. The bicarbonate of soda in particular may be taken in very large doses for a succession of years without the least detriment to the general health. The writer was acquainted with a medical practitioner in this metropolis, who for the last twenty years of his life had not gone to bed any night without swallowing two small rhubarb pills, which he washed down with a handful of bicarbonate of soda, stirred into, rather than dissolved in, a glass of water. This gentleman had a weak stomach, and suffered from the generation of acid in the primæ viæ, but at seventy-two he was as active as most men are at fifty, and he looked ruddy and well; indeed the writer has observed that individuals who habitually make use of bicarbonate of soda to neutralize acid in the stomach, have unusually brilliant complexions, a circumstance which recent discoveries enable us to explain.

When circumstances permit, the best of all modes of taking the bicarbonate of soda, is to repair to the well-head of some of the natural mineral waters in which it is contained. The mineral waters of Vichy in particular, which hold in solution about one part of bicarbonate of soda in 200 of the menstruum, quickly render the urine of the drinker neutral or alkaline, and afford great relief to the unhappy sufferer with gravel and urinary calculus. The waters of Selters, Obersalzbrunn[1], Aix la Chapelle, Pouges, Spa, Carlsbad, &c., also contain carbonate of soda in variable and smaller quantities, and have long deservedly enjoyed much celebrity for their virtues in certain forms of gravelly complaints. But it is not necessary to travel so far as France, Germany, or Bohemia, for water impregnated with carbonic acid and holding a little bicarbonate of soda in solution; this can be prepared on the spot anywhere, and if a man will but consent to pay some little attention to his health, to follow a regulated diet, and to spare both his mind and body for a season from the worry of business and the eager pursuit of gain, he may almost choose his residence where he pleases, provided it be but airy and healthful. Nay, immense benefit is often derived from a course of *pure water*, or at least of water the saline impregnation of which is very trifling, and cannot have any chemical influence upon the matter of which calculous concretions are formed.

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[1] See an interesting case of nephritic calculus brought away, and a long period of suffering from gravelly complaints completely removed by the use of this water, in the person of Dr. Lebenheim, of Trebnitz, related by himself, in vol. xlix. of Rust's Magazin. He voided as many as twenty calculi of different sizes at once. The pelvis of one if not of both kidneys must have been full of concretions.

Instead of the alkalis, the alkaline earths, as they used to be designated, lime and magnesia, are sometimes advantageously prescribed in gravelly complaints. Occasionally these substances have even seemed to prove more beneficial than the bicarbonates of potash and soda. But the efficacy of lime, especially in many cases of gravel, may, we feel persuaded, be generally ascribed to the state of great dilution in which it is necessarily taken. Equal parts of lime-water and rennet whey form an excellent diluent in these cases. A very elegant mode of administering magnesia, is to prescribe it held in solution in water by an excess of carbonic acid. The same means is applicable to lime also. Two, three, or four pints of this super-carbonated magnesian or lime-water may be taken in the course of the day with excellent effect.

IV.—*To attempt the expulsion and disintegration or solution of the grit or concretions of lithic acid already formed.*—This is an all-important indication. Whoever, with his urine habitually depositing a sediment, experiences a certain amount of uneasiness in the region of the kidneys, especially if he observes a few gritty particles voided from his bladder, should immediately take alarm, and by all means make sure that no crystal remains behind to serve as a nucleus for future deposition. The use of mild diluents, which may be made the vehicles of the alkaline carbonates, is here of the first necessity; and this, with attention to the state of the functions generally, to the regulation of the diet, &c., will often be sufficient. But if pain in the lumbar region continue unabated, and febrile symptoms be lighted up, it may be necessary to abstract blood from the arm, or by cupping-glasses from the seat of the pain, to make use of the warm bath, and especially of the hot air bath, and to purge the bowels freely with calomel, and the senna draught with crystals of tartar. There are certain medicines, too, which seem occasionally to have a kind of specific effect in expelling gravel with the urine; these are the balsams and turpentines. A full dose of the *Dutch drops*, *i. e.*, essential oil of turpentine, has often been followed by a kind of explosion of gravel from the kidneys, and complete relief of the pain and uneasiness that had for some time been endured. This popular remedy may be tried with advantage in some cases.

Should the symptoms indicate that a concretion is engaged in the ureter, these means will all be proper. In case the pain is not very severe, or when it has been mitigated by general remedies, and there is no longer any tinge of blood in the urine, we may sometimes venture to prescribe an emetic of ipecacuanha, so as to produce full vomiting; or to recommend motion on foot, or in a carriage on a rough pavement. The powerful action of the abdominal muscles induced by the one, and the succussions encountered in the other, have occasionally been found efficient in promoting the onward progress of the concretion; some persons, indeed, have lived in ignorance that they were affected with renal calculus, until a rough shake from an accident has dislodged it, and procured its expulsion. These measures, however, are to be recommended and resorted to with great caution. The passage of a calculus along the ureter is generally a very painful process, and one that is always accompanied with a certain degree of hazard; the concretion may become impacted in the ureter, completely close up its canal, and so interfere directly and by sympathy with the function of the kidney, an event of all others the most to be deprecated. It is better to wait the tardy processes of nature, assisting her by means of low diet, the local abstraction of blood, topical fomentations, the warm and hot air bath, saline aperients, and the free use of diluents.

In the majority of cases, after the lapse of twenty-four, thirty-six, or forty-eight hours, the febrile symptoms abate, the urine flows freely, and brings away either a quantity of gritty particles or one or more concretions of larger size, to the complete relief of the patient.

But granting a concretion formed, it does not necessarily remain lodged in the urinary passages, merely because we have not had ocular demonstration of its expulsion. We do unquestionably sometimes succeed, whatever may have been said to the contrary, in annihilating them in their seat, a fact in support of which several cases might be adduced.

Renal Calculi of the Oxalate of Lime.—Should we have evidence that the oxalic diathesis is the one which is present along with symptoms of renal calculus, should we at any time detect an amorphous sediment of oxalate of lime among pulverulent sediments of lithic acid, and especially should the attack of nephritic colic supervene unexpectedly and without any precursory evidences of a deranged state of the urinary secretion, the urine never having been remarked as otherwise than clear, and to all outward appearance healthy, there will be strong reasons for concluding that the oxalate of lime is the matter deposited in the pelvis of the kidney.

Under these circumstances the treatment need not vary from that recommended under the existence of the lithic acid diathesis. There is always something of the same hypersthenic condition of the system, though probably this is less marked than in the lithic state. Until the *fit of gravel* has occurred, too, there is generally less of febrile excitement under the oxalic than under the lithic diathesis. The constitutional treatment then may be of the kind just recommended. The antiphlogistic regimen must be enforced; the bowels freely purged; saline medicines prescribed, the warm bath, &c., employed as before. Diluents, too, must be ordered in profusion, and they may be medicated in the manner already recommended with the bicarbonate of potash or soda, less with a view, however, to the disintegration of the concretions, than to wash them out and prevent their lodging permanently any where in the course of the urinary passages.

Occasionally there are accidental circumstances connected with the formation of concretions of salts of the oxalic acid, which must be held important, and which it is necessary to be aware of and to set aside. These salts have in fact in some cases been evidently deposited in connexion with, and there seems no reason to doubt in consequence of the mode of life of the individual. Thus M. Magendie relates a case of a gentleman who suffered from a fit of gravel, and passed several concretions of the oxalate of lime after having long indulged habitually in sorrel as an article of food; and M. Ratier[1] has given the particulars of another case in which many concretions, as he says, of the *oxalate of ammonia*[2] were deposited in the pelvis of the kidney and subsequently evacuated after great suffering, from the continuous use of the same substance as food. It was computed that M. Ratier's patient had been in the habit of consuming about half a pound of sorrel daily for three years, when he suffered the nephritic attack that was terminated by the discharge of rather more than half a drachm by weight of concretions of the substance mentioned, some of which were as large as peas. The treatment followed in this case was antiphlogistic, combined with the free use of diluents containing two drachms of bicarbonate of soda daily, which brought the urine to show alkaline reaction, and put an end to the fever and other symptoms with which the attack had been accompanied.

Dr. Prout has suggested another plan of treatment in cases where oxalates are deposited from the urine, namely, by converting the prevailing diathesis into that in which the lithic acid is excreted. But it is, in the first place, questionable how far this is really practicable; and in the second how far it were advantageous, supposing it might be done. The oxalic and lithic diatheses often alternate one with another, it is true, and under the use of muriatic acid the lithic acid will begin to be deposited abundantly in many cases. But are we quite sure that there is not also oxalic acid elaborated at the same time, and in consequence of the treatment by possibility even in greater quantity than before? And if a nucleus be present upon which deposition can take place, as in the case supposed, the advantages of having the lithic acid substituted for the oxalate of lime are not great enough to compensate for the more rapid growth of calculi when they consist of the lithic acid or the lithates.

The renal calculus of oxalate of lime is generally of a dusky or greenish brown, or of a bluish gray colour; in the latter case and when quite smooth, as sometimes happens, it constitutes the *hemp-seed* calculus, from its resemblance to the seeds of that plant. When the concretion is of larger size, it is generally tuberculated on the surface. Occasionally the oxalate of lime is passed from the kidney in the shape of an aggregation of well-formed crystals. In any form its chemical qualities render it easily recognizable:—its insolubility in the cold nitric and muriatic acids, its becoming charred and then growing rapidly white before the flame of the blow-pipe, a bulky ash remaining, which shows alkaline reaction, effervesces in a dilute acid, and consists of a mixture of oxide of calcium and carbonate of lime.

Renal calculi of the lithic oxide.—The *lithic, uric,* or *xanthic oxide* has not, so far as we know, presented itself as the subject of observation in the shape of a concretion voided directly from the kidney. Dr. Marcet however met with it in the kidney after death, and a large calculus of the same substance, extracted from the bladder by Professor Langenbeck of Gottingen, has recently been analyzed by the distinguished chemists Liebig and Woehler. It is so rare that it can only be regarded as matter of curiosity. In its chemical qualities this substance agrees in many particulars with lithic acid. It has been shown, however, to be essentially different. It forms a yellow solution in hot nitric acid, which becomes of a reddish tint when neutralized by potash. Before the blow-pipe it decrepitates, gives out a very peculiar odour, and leaves a slight ash behind.

Renal calculi of cystine.—The number of cases in which the peculiar animal product called *cystic oxide* or *cystine* has been seen as the constituent matter of renal calculus or gravel, and has either been traced or taken immediately from the kidney, far exceeds those in which it has been extracted from the bladder by operation or after death. The specimens examined have all been remarkably pure; only two instances indeed are on record in which the cystic diathesis appears to have been followed by any other, and in both of these instances this was the lithic.

The treatment of the state of system along with which cystine is deposited in the kidney is somewhat doubtful. Dr. Prout expresses an unfavourable opinion of this form of complaint, from the circumstance of its having very generally been encountered in alliance with diseased kidney and as an hereditary malady. In the earlier stages of diathesis, it is probable that the antiphlogistic plan and the alkalis administered cautiously, would give the greatest chance of relief. When it occurs in conjunction with an irritable state of the system, however, an opposite course should be pursued. In the case in which the writer detected cystine in the urine, the individual was of an excitable habit of body, and alkaline medicines, though they relieved the acidity of stomach under which he often laboured, never failed to aggravate the general constitutional malady. The muriatic acid, on the contrary, united with light tonics and anodynes, especially the hyoscyamus, always proved serviceable.

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[1] Journ. Général des Hopitaux, quoted in Nouv. Biblioth. Méd. tom. iv. p. 254. 1828.

[2] There must surely be some mistake here. OXALATE OF AMMONIA is a very soluble salt; and its existence is impossible in a fluid such as the urine, which contains lime in abundance. Oxalate of ammonia is immediately decomposed by the urine, oxalate of lime and phosphate of ammonia resulting.

Dr. Wollaston called cystine by the name of cystic oxide, from its resembling certain metallic oxides in being alike soluble in acids and alkalis. Cystine is in fact distinguished chemically by its solubility in the dilute nitric, muriatic, sulphuric, oxalic, and phosphoric acids, as also in caustic ammonia, potash and soda, and in the carbonates of the two latter alkalis. But the acetic, tartaric, and citric acids, and the carbonate of ammonia, not only do not take it up, but even throw it down from its states of solution. Before the blowpipe it emits a very fetid and characteristic odour, and is entirely consumed. When we find a concretion that dissolves indifferently in dilute muriatic acid and in a solution of carbonate of potash, we may be certain that we have a specimen of cystine under examination.

Renal calculi of the phosphates.—When we take into account the numerous cases in which we observe the urine depositing the ammonia-phosphate of magnesia and the phosphate of lime, we cannot but be surprised that the phosphates in the shape of gravel should so seldom be encountered. Although among the most common of the matters composing the outer layers of calculi that have remained long within the body, it is quite certain that scarcely any substance more rarely constitutes the nucleus of these concretions than the triple phosphate of ammonia and magnesia or the phosphates of lime. The crystals of the triple phosphate, indeed, at all times show but little disposition to cohere so as to form a cluster. Even when forming on the lower surface of a urinary film they always drop away and subside to the bottom singly. The phosphate of lime too precipitated from a state of solution shows itself as one of those dry unplastic powders which are very little apt to coalesce into a mass. Besides, with the phosphatic state of the urine we have generally so free an action of the kidney, that any particles accidentally deposited, are almost certainly washed away immediately, as shown by the whey-like, semi-opalescent urine which so commonly accompanies the diathesis. Farther, the phosphatic diathesis cannot in general well be held the sign of an original morbid state of the kidney; it is very commonly the consequence and termination of other faulty conditions of that organ; when deposition does take place during its existence, this most commonly happens upon nuclei already provided.

Nevertheless, exaggerated states of the phosphatic diathesis are occasionally followed by depositions within the kidney, either of the ammonia-phosphate of magnesia, of the phosphate of lime, or of these two salts simultaneously. In the first instance the concretion consists of an aggregation of very white shining crystals of a cubical shape, with something of a pearly lustre; in the second, of small rounded masses of a white or dirty white colour, smooth or polished on the surface, and of a dull chalky fracture; and in the third, of a mixture of glistering particles, and a lustreless amorphous powder.

The ammonia-magnesian phosphatic gravel is readily distinguished by the odour of ammonia it gives off when digested in liquor potassæ, and by its ready solubility in dilute nitric acid, from which it is again precipitated in its characteristic white glistening crystals on the addition of an alkali. Under the blowpipe this substance exhales the odour of ammonia, and at length melts with difficulty. The phosphate of lime, again, is distinguished chemically by its infusibility before the flame of the blow-pipe. It dissolves readily in muriatic acid, however, without effervescence, and is precipitated again in the form of an impalpable white powder on the addition of an alkali. These two substances often occur associated, probably not in chemical combination, but simply intermixed. We are not aware that they have in this state been detected composing renal concretions or calculous nuclei. But they certainly form the outer laminæ of a very considerable proportion of all the calculi, especially of all the large calculi that exist. The compound is chemically distinguished by its ready fusibility before the blow-pipe. It also dissolves completely in dilute muriatic acid. From this solution the lime is precipitated by the addition of oxalate of ammonia; the magnesia afterwards falls before solution of ammonia.

Renal fibrinous concretions.—Calculous depositions in the kidney, and the passage of these substances along the ureter, often give rise to the discharge of blood with the urine. Sometimes the blood comes away in the shape of small clots with gritty matter adhering to their surface. What has been called the *fibrinous calculus* is probably formed from one of these clots detained in the urinary passages, and washed in a considerable measure free from the colouring matter. Various other pathological states of the urinary organs are attended with the effusion of blood, and one of these may give rise to the clot which becomes condensed, and washed, and moulded into the form of a calculus. The fibrinous calculus described by Dr. Marcet, resembled yellow wax in colour and consistence. Its structure was fibrous, and it was somewhat elastic. Its chemical qualities were those of fibrine: it was soluble in caustic potash, from which it could be precipitated by the addition of a mineral acid. It was also soluble in acetic acid with the assistance of heat, and was precipitated by means of the ferrocyanate of potash. Sir B. C. Brodie is the only other practitioner who seems to have met with this peculiar calculus subsequently to Dr. Marcet. It was found in the bladder after death in a case where no affection of the organ had been suspected. It was of an oval shape, about the size of a horse-bean, yellow, semitransparent, not very unlike amber in appearance, but less hard. Soft masses of this kind, coated with a calculous crust, have been occasionally removed from the bladder by the operation of lithotomy. This sort of deposit also takes place on abnormal growths, from the bladder, and sometimes on the internal cicatrix left after lithotomy.

There is yet another form of concretion, very lately described by Dr. Hodgkin, which can scarcely be called urinary, although it was taken from the bladder of a boy after death; its presence, owing to its peculiar constitution, not having been satisfactorily ascertainable by sounding during life, although all the symptoms of stone in the bladder were manifest. This concretion, instead of being hard and stony like calculi in general, consisted of a series of concentric layers of a white elastic substance, apparently like cheese or coagulated albumen, containing between each of them a thinner layer of very friable earthy matter, probably phosphate of lime, though this is not stated. When struck by the sound, this mass of course gave no other sensation than is communicated by the lining membrane of the bladder. It was in all likelihood, as stated by Dr. Hodgkin, the product of a morbid state of the urine, which must have contained, at different times, portions of the fibrinous matter of the blood. A nucleus of this must have been formed in the first instance, accidentally; the irritation engendered by the presence of the foreign body in the bladder caused the elaboration in extra quantity of the phosphates which were deposited on the nucleus; then came a renewal of the albuminous state of the urine with the envelopment of the phosphatic layer by a stratum of coagulum, and so on. There were two of these stones in the bladder, each about the size and shape of a pigeon's egg[1].

Brugnatelli, in his Litologia Umana, speaks of two calculi, the outer laminæ of which consisted of a semi opaque horny substance, a line in thickness, smooth and polished on its surface, and fibrous in its structure. This substance burned with the odour of horn when thrown on hot coals, and was probably of the nature of albumen. He also describes and gives a figure of what he calls a calculus of crystallized albuminous matter, probably a specimen of the cystic oxide calculus. When broken, the fragments were transparent and amber-coloured. It contained no nucleus.

Vesical calculi.—Small stones either immediately or soon after their arrival in the bladder are frequently carried out from that viscus by the gush of the urine. But from a variety of circumstances, the concretion is apt to lodge in the bladder, and then, in virtue of the ordinary laws of chemical attraction, it begins to grow by having fresh matter deposited upon it, and very speedily acquires such dimensions, that it can by no possibility be discharged through the natural passages.

The calm that follows the escape of a renal calculus from the ureter into the bladder is deceitful and may impose upon the patient, but it ought not to lull his medical adviser into a false security, the evil of which is so serious that one is almost tempted to regret this temporary relief. Did the pain continue, efforts to secure the onward progress or the dissolution of the stone would not be remitted, and these in the great majority of instances would prove successful; where they failed, the bladder would be searched, and the nucleus being seized with a proper instrument, would be crushed and extracted without any suffering worth speaking of.

As a preparation for its expulsion through the natural passage, a large bougie may be introduced from day to day for a short time; the urine increased by diluents being then allowed to accumulate, when the desire becomes urgent, the concretion may often be discharged in the full flow that follows the withdrawal of the bougie. This event may also be favoured by the position which the patient is directed to take for this purpose, such as leaning forward, or resting on the hands and knees, &c.

The treatment should therefore be persevered in, and if at the end of a week or ten days the concretion be not voided, an exploration should be made in order to its extraction.

If the foreign body be not removed, it becomes a centre for the precipitation of the less soluble constituents of the urine, whereby it increases in size, and sooner or later inevitably proves such a source of suffering that life becomes a burden.

This deposition takes place also on foreign bodies of a different kind that find their way, no matter by what means, into the bladder. Thus a bodkin or needle, a hair pin, a large corking pin, an ivory tooth-pick, a hazel-nut, teeth, a piece of tobacco-pipe, the stems of plants, part of a bougie, fœtal bones, masses of hair, clots of blood, growths from the inside of the bladder, &c., &c., have severally been found in the centres of calculi, which had either been voided, extracted by an operation, or discovered after death.

When the surgeon's efforts prove unsuccessful, and the stone is retained in the bladder, its presence gives rise to a train of symptoms, which, together with their treatment, will be described in the articles Lithotomy and Lithotrity.

Bibliography.—*Kentman*, De Calculis corporis humani. Zurich, 1565. *Ferrand*, De Nephritidis et

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[1] Guy's Hospital Reports, vol. ii. p. 268.

Lithiasis causis et curatione, ex Græcis aliisque collectis. Paris, 1570. *Boscius*, De Lapidibus qui nascuntur in corpore humano, præcipue renibus ac vesica, et ipsorum curatione. Ingolstadt, 1580. *Wecker*, De Lithiasi. Bale, 1592. *Mockius*, De Causis Concretionis et Dissolutionis, tam externæ quam internæ, corporis humani. De Lithiasi, seu Morbo Calculoso. Fribourg, 1596 and 1614. *Schenk*, Lithogenesia. Francfort, 1608. *Hoschchilt*, De Calculorum Generatione. Bale, 1616. *Van Helmont*, De Lithiasi, in Op. Omn. *Schobinger*, Lithologia Medica. Bale, 1637. *Rolfink*, De Generatione Calcul., signis et remediis. Jena, 1663. *Schneider*, De Calculo. Wittemberg, 1650. *Borrichius*, De Lap. Generatione. Ferrara, 1687. *Faschius*, Historia et curatio Calculorum human. Jena, 1676. *Mezger*, Scrutinium Lithog., a work chiefly on Biliary Calculi. Tübingen, 1683. *Kœnig*, Lithol. humanæ specimen. Vienna, 1689 & 1696. *Boerhaave*, Prælect. De Calculo. Göttingen, 1752. *Vidal*, Traité sur la production des Pierres dans le corps humain. Chambéri, 1723. *Tenon*, Recherches sur la nature des Pierres du corps humain, in Mém. de l'Acad. 1764. *Vicq. D'Azyr*, Obs. sur les Concrétions animales en Mém. de l'Acad. Roy. de Méd. 1779, 1780, and 1781. *Estrade*, Mémoire sur la manière dont se forment les Pierres dans le corps humain et sur les moyens de les dissoudre. Martinique, 1790, *Fourcroy*, Sur le nombre, la nature et les caractères des Calculs, &c. in the Annales du Musée. Paris, 1802. *Marcet*, Essay on the chemical history and medical treatment of Calculous Disorders. London, 1817. *Henry*, On Urinary Concretions in the Med. Chir. Transactions, vol. x. p. 123. *Volkel*, De formatione Calculor. Breslau, 1822. *Civiale*'s statistical work on Calculous Diseases, and *Willis.*

(*R. Willis.*)

CALLUS. The organic substance effused between the extremities of fractured bones, and by means of which they become solidly united. The process of its formation will be described under the head of Fracture.

CALOMEL, (*hydrargyri chloridum*, vel *protochloridum*) is a compound of metallic mercury with one equivalent of chlorine, and is usually met with in the form of a ponderous yellowish white powder, of a feebly nauseous smell and taste. It may truly be styled the most important preparation of mercury; and indeed there is scarcely any medicine which equals it in the mildness yet activity and certainty of its operation, and which is capable in various doses and combinations of fulfilling so many and so important therapeutical indications. Its general influence on the economy is that of a most energetic evacuant and antiphlogistic; increasing all the secretions, and lowering the circulation and nervous energy. In surgical practice it is available as a purgative; as a remedy for inflammation, acute and chronic; as an antisyphilitic; and as a local application: on these respective uses we must speak somewhat in detail.

As a purgative, calomel is seldom employed amiss, when inflammation has to be combated or prevented in vigorous constitutions. But the cases in which its good effects are most prominently displayed are those of cachectic inflammations accompanied with a vitiated state of the abdominal secretions; as for instance in many cases of scrofula—in inflamed and irritable ulcers arising in bloated habits—in erysipelas, carbuncle, whitlow, boils, and other lesions of the skin—and in cases where slight injuries seem likely to originate spreading inflammations, or tetanus. The dose as a purgative is from two to six grains, which may sometimes be combined with a fourth or half-a-grain of tartar emetic, or with three or four grains of James's powder, to aid in lowering the pulse and restoring the secretions of the skin; or with a few grains of camphor, or extract of henbane, or a small quantity of opium, when the pulse is feeble, or there is much nervous irritability. In either case the calomel should be followed after a short interval by an aperient draught. As a general rule, the dose may be repeated as long as the condition of the patient, and the aspect of the stools continue to improve under its use; recollecting, however, that the continued employment of calomel is of itself sufficient to render the stools green and slimy: and bearing in mind the practical caution of Dr. Armstrong, that after the skin of a child has become cool and perspirable it cannot be continued freely without hazard of violent salivation.

The experiments of Mr. Annesley have given rise to the theory that large doses of calomel diminish, whilst small doses increase, the vascularity and irritability of the stomach. At all events ten or twenty grains (with or without a grain or two of opium) will sometimes be found to check obstinate vomiting, whether arising from inflammation within the abdomen, or from that state of constitutional disturbance which Mr. Travers terms "*prostration with excitement*," and which frequently succeeds violent injuries, especially burns.

The employment of calomel, so as to affect the system as an antagonist to inflammation in general, is quite of modern date. It seems to have been first publicly advocated in this country in 1785 by Dr. Hamilton, who, from a consideration of its known efficacy in hepatitis and certain forms of ophthalmia, was induced to extend its use to other inflammations likewise; and as the practice has received the favorable suffrages of almost every succeeding writer of authority, it has now become universal. How or why its beneficial effects are produced, it were vain to inquire. Dr. Farre advanced the theory, that the action of mercury is one which essentially weakens the adhesion of parts; and this, although by no means receivable as an explanation of the cause, is still a sort of key to its practical application. For the inflammations in which calomel is most serviceable are those which tend to produce adhesion or effusion of organizable lymph, whether on the surface of a serous membrane, as the iris or peritonæum, or in the interstices of an organ, as the lungs or testicle. And in these cases it seems capable (when administered with proper adjuvants) not only of extinguishing the diseased action of the capillaries, but also of causing absorption of the matters effused, and restoring the part to its healthy structure. On the other hand, in the inflammation of mucous and synovial surfaces, its efficacy is by no means so decided; it is unquestionably useful as a general antiphlogistic, but cannot be depended upon to work out the cure. Again, there are some inflammatory cases in which it is positively injurious, if exhibited in greater quantities than is necessary to evacuate and improve the abdominal secretions. We may adduce as examples, hospital gangrene, phagedenic venereal sores, malignant tumours, and other diseases tending to rapid suppuration or ulceration[1]; processes for the repair of which the adhesive inflammation is, as Dr. Farre observes, above all things necessary. The utility of calomel may depend also on the specific nature of the inflammation; thus it is the *sine qua non* in syphilitic, but prejudicial in gouty iritis. Much also depends on the powers of the constitution; thus it must always be administered with caution to the scrofulous, and in chronic cystitis it may, according to Brodie, be cautiously tried if the strength is unimpaired and the urine still acid, but not if the patient is effete with age and debility. The diseases of the eye afford a good illustration of these remarks. In iritis, and in inflammation and deposition of lymph between the layers of the cornea, the curative effects of calomel are unquestionable. In gonorrhœal ophthalmia it no doubt aids in removing the acute stage of the inflammation, but is not to be expected to complete the cure. Lastly in onyx, and strumous ulceration, it is positively injurious, if given so as to affect the system.

But when speaking of calomel as a remedy for acute inflammation, it is by no means to be understood as a substitute for blood-letting. The prospect of relief from calomel must never deter the practitioner from bleeding when the pulse and the state of the disease demand it. In such a case the calomel is a secondary agent; it will expedite the cure, shorten convalescence, and may prevent the necessity of a second bleeding, but must not supersede its primary employment. In fact, not only in many cases will the calomel be unable to affect the system unless preceded by bleeding, but there is no small ground for believing, (as some English authors contended thirty years ago, and some foreigners do still,) that mercury accumulated in the system during acute inflammation will but hasten suppuration and ulceration if other antiphlogistic means be neglected—a fact which used formerly to be but too lamentably evidenced in the treatment of inflamed primary venereal ulcers and bubo[2].

On the other hand the anti-inflammatory virtues of calomel are most happily displayed when acute inflammation of some vital organ is lighted up in a constitution drained of blood, and exhausted by privation or previous disease. When blanched lips, and a rapid feeble pulse forbid more than a very sparing abstraction of blood (if any), it is to calomel, combined with opium, that the practitioner must look for aid.

The manner in which calomel is administered in inflammation is in repeated doses, till the mouth begins to suffer; and it is then that the disease generally begins to yield. A *slight* affection of the mouth is all that is desirable. For although we must agree with Dr. Elliotson that it is better that one patient in three should be violently salivated than that one in three should be lost, yet there are few affections which create so much immediate suffering, or which tend in the future so materially to impair health, comfort, and personal appearance, as violent ptyalism: the surgeon therefore should examine the mouth at every visit, and hold his hand as soon as the calomel begins to tell upon the disease or on the system. In children, salivation is neither very easily, nor very safely produced; copious green stools are an equivalent; and in more than one instance has a fatal enteritis been the consequence of pushing the calomel recklessly after their appearance.

The dose, and frequency of its repetition, must be proportioned to the urgency of the case. In exceedingly rapid diseases, such as acute laryngitis, scalds of the glottis through drinking boiling water, puerperal peritonitis, and acute tetanus, ten or twenty grains are sometimes given every hour or two; although there are many practitioners who believe that it would act quite as soon in more moderate doses. In ordinary acute inflammations, meningitis succeeding injuries of the head, iritis, abdominal inflammation after strangulated hernia, testitis, erysipelas of the head, and so forth, it is given in doses of from one to five grains at intervals of from one to eight hours. If the patient is an adult, and there is no cerebral inflammation, a fourth or half a grain of opium may be added if it tends to purge; and this combination of calomel with opium is of singular service when acute inflammation co-exists with great debility; or when the pulse becomes very sharp and rapid after bleedings. A small quantity of antimony is a useful addition when nausea would not be injurious. In inflammations of a more chronic grade, or cases in which it is wished to excite absorption of thickening or lymph,—chronic testitis for instance, it may be given in doses of from two to four grains daily, with or without opium. In such cases Ricord recommends the following formula :—

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[1] Mr. Malcolmson, in his paper on hepatitis (Med. Chir. Trans. vol. xxi.), speaks of calomel as decidedly injurious in that disease, after suppuration has commenced.

[2] There is one modern surgeon, Mr. Babington, who has advanced opinions directly the reverse of those here stated. He says that mercury will depress arterial action with no less certainty than antimony; that as long as acute inflammation accompanies a phagedenic sore, mercury will never occasion or aggravate sloughing; that it may be used either with or without bleeding, antimony, &c. quite indifferently; and that it may always be employed in the treatment of sloughing sores when the surface is swelled, and the margin of an arterial red colour. I believe these opinions as to the identity of the operation of bleeding, calomel, and antimony, to be quite opposed to those of most people at the present day.

"Pilules de Calomel composées.

"℞ Calomel. ℈j ; Pulv. Conii, Saponis, āā. ℈ij. M. fiant pilulæ viginti quatuor.—Dose, from one to six pills daily."

Some foreign physicians still entertain a horror of affecting the mouth in acute inflammation, and adminster calomel in repeated doses combined with purgatives. Burdoch almost idolizes a combination of calomel with nitre, which produces free purging but no salivation.

There is a large class of acute inflammations of no great intensity or danger, such as gonorrhæa[1], and sundry cases of erysipelas and of rheumatism ; and a still larger class of chronic affections of the skin, eye, and other parts, in which calomel is highly beneficial as an *alterative :* that is, when given so as to produce a silent change upon the system ; to extinguish feverishness, increase and rectify the secretions, equalize the circulation, and promote absorption, without any one remarkable evacuation, and without affecting the mouth. For many of these cases, the Plummer's pill is very popular and very useful. One pill, containing one grain of calomel, one grain of the red sulphuret of antimony, and two grains of guaiacum, is generally administered every night at bed-time.

As a means of mercurialising the system for the cure of primary syphilis, calomel is not very frequently employed, because of its tendency to act on the bowels and reduce the strength. But many practitioners find it very useful in treating soldiers, railway-labourers, and other individuals of robust habits, whom the milder form of blue pill would not affect with sufficient quickness and energy. It is also sometimes given in very small doses in the congenital syphilis of infants. Of its utility in acute inflammations connected with constitutional syphilis and in small alterative doses in some forms of syphilitic cachexy, we need not speak in this place.

About the latter end of the last century a Mr. Peter Clare recommended calomel to be rubbed on the inside of the cheeks as a means of affecting the system. It soon salivates, and unless the patient swallows his saliva, does not purge. But although not without its advantages, this method has fallen into utter disuse. More recently, Biett has administered it in a somewhat similar manner. He causes from eight to twenty grains mixed with starch to be used daily as snuff, and has found this plan very efficacious in tubercular and other syphilitic cruptions on the skin.

As a local application, calomel possesses stimulant and alterative properties resembling those of the ammonio-chloride or white precipitate, but milder.

In the form of ointment, made with one drachm to an ounce of fresh lard, it is recommended by Ricord as a dressing for primary venereal sores of the Hunterian or indurated character ; it is also useful in porrigo favosa, prurigo senilis, impetigo, eczema, herpes circinatus, sycosis, lepra, and other chronic cutaneous affections, in which a mild stimulant is advisable. Mr. Pereira says, that if he "were required to name a local agent pre-eminently useful in skin diseases, he should fix on this." The following formula is recommended by Scarpa in leucoma :—

"℞ Tutiæ pp. ʒj ; Aloes Socot. pulv. gr. ij ; Calomel. gr. ij; Adipis Suillæ ℥ ſs ; Misce ; fiat unguentum."

In the form of powder, its applications have been manifold. It has been snuffed up the nostrils with benefit in ozena. It is sometimes mixed with finely powdered sugar, and blown into the eye, to cause the absorption of nebulæ ; a coarse practice, and not a very safe one. Dr. Fricke recommends it to be applied to the eye by means of a hair pencil one in twenty-four hours, in cases of nebulæ and granular conjunctiva. He says that it produces very slight pain of no long duration, or even sometimes a sensation of cold, and that it greatly diminishes the intolerance of light in rheumatic ophthalmia. But in two cases it produced very disagreeable results, which, as the patients were taking iodine at the time, he ascribes to the formation of an iodide of mercury in the eye. Ricord says that the venereal eruption, which he denominates *mucous tubercle*, *mucous pustule* or *flat pustule*, is speedily removed by washing the parts twice a day with solution of chloride of soda, diluted so as to cause slight smarting, and sprinkling them afterwards with calomel. In croup, and in *diphthérite*, a peculiar inflammation of the fauces with croupy exudation, calomel has been blown upon the diseased parts to stimulate them to throw off the false membrane ; but with no very good results. It has also been used for the same purpose in a peculiar ulcerative affection of the skin, resembling dipthérite in its characters, and epidemic in some parts of France.

Mixed with honey, calomel has been used as a gargle in venereal sore throat ; and suspended in mucilage has been injected into the urethra in gonorrhœa, but with no great benefit.

When combined with lime-water in the proportion of a drachm or two to a pint, calomel forms the *lotio nigra*, or *black wash ;* an admirable soothing cleansing application for venereal sores, and irritable or cachectic ulcers in general.

For further notices respecting the *modus operandi* and employment of mercury generally, consult the articles INFLAMMATION, MERCURY, SALIVATION, and SYPHILIS.

The following works will be found to contain almost everything known respecting the uses of calomel in modern surgical practice.

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[1] Although no one can more strongly reprobate the custom of salivating gonorrhœal patients, after the manner formerly practised in the Borough hospitals, as narrated by Sir A. Cooper in his lectures, still I am sure that the administration of one or two grains of calomel every night is a most effectual way of shortening the acute stage of gonorrhæa, and of preventing protracted chordée.

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(*Robert Druitt.*)

CAMPHOR. *Canfur*, Arab.; *Kampfer*, Ger.; *Camphora*, Lat. This well-known substance is the product of many members of the vegetable kingdom. It is contained in the sassafras, zedoary, peppermint, and all that class of aromatic plants, whose pungency is succeeded by a sense of coolness on the tongue. But it is from the Laurus camphora, a native of Sumatra, that it is obtained in quantities sufficient for the purposes of commerce and medicine.

After its importation it is purified by repeated sublimations; and when it reaches the apothecary in its finished state, is in the form of hemispherical cakes, white and translucent, crystalline in texture, and of a peculiarly fragrant smell and taste. We need scarcely say that it is exceedingly volatile; that it is very sparingly soluble in water, but that it dissolves very readily in alcohol, ether, the fixed and volatile oils, and the strong acids; from which, however, it is immediately precipitated by the addition of water. Moreover, when distilled with strong nitric acid, it is converted into a peculiar acid called the *camphoric;* and when distilled with argillaceous earth it is converted into a peculiar oil, called *oil of camphor*[1]. But the terms camphoric acid and oil of camphor have both been improperly applied to a mere solution of camphor in nitric acid; a combination which has certain surgical uses, which we shall mention presently.

The effects of camphor on the animal economy differ very much according to the quantity administered, and the state of the recipient. Sometimes it increases vascular and nervous excitement, and sometimes diminishes them; and some doses will often produce during health the very same symptoms which other doses will remove in disease.

Small doses, such as five grains, produce scarcely any effect on healthy persons. Larger doses, such as fifteen or twenty grains, have been found by repeated experiments to cause fulness and rapidity of the pulse, flushing of the countenance, brilliancy of the eyes, and mental excitement resembling intoxication; the urine was passed frequently, and with a sensation of heat, and during sleep there were frequent *erectiones cum emissione*[1]. In larger doses still, such as two scruples, it has been known to cause giddiness, chilliness, languor, and confusion of intellect, gradually passing into total unconsciousness, and followed by convulsive fits and maniacal frenzy[2].

When judiciously administered in disease, we find it capable of allaying pain and spasm; but its principal use is that of combating delirium, convulsions, and excitement of the genitals, the very symptoms, which, as we have just shown, it is most liable to create in healthy persons. If therefore its action requires to be named, we must call it, not merely stimulant or sedative, but rather a *perturbative* or *alterant* of the general state of the nervous system[3]. And in this respect it resembles the oil of turpentine, which is very nearly allied to it in chemical composition. For this latter substance, although a powerful stimulant, is yet capable of acting as a very valuable sedative, when properly administered. When camphor is taken internally, it is absorbed into the blood, its odour permeates all the tissues, and is exhaled from the lungs, and it frequently causes profuse perspiration.

Camphor appears to be administered with most benefit when nervous derangement accompanies a depressed state of vascular action. In the delirium which often succeeds severe injuries, in typhoid fever attending gangrene, in the disease arising from dissection wounds, and in severe cases of carbuncle and phlegmonous erysipelas, the surgeon may often employ it with benefit. A very good form is the *strong camphor mixture* of Dr. Hooper, made by triturating half a drachm of it with a little magnesia or almond confection, and adding six fluid ounces of water. The dose is one fluid ounce every two or three hours. Of course it will be easy to add ether, opium, or ammonia, to this mixture, or to substitute decoction of bark for the water if desirable. The *compound tincture of camphor* of the London Pharmacopœia, each drachm of which contains a quarter of a grain of opium, and rather less of camphor, is a good preparation for children after severe burns, or at other times when they require cordials and opiates. Milk is an excellent vehicle for camphor, forming with it a smooth emulsion, which does not spontaneously separate[1].

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[1] Bouillon-Lagrange. Manuel d'un Cours de Chimie. Paris, 1812. tom. ii. p. 210. See also, An. de Ch. vol. iv., p. 180.

[1] Lucas Scudery, M.D. Arch. Gén. de Méd. vol. xxi., p. 131.

[2] Alexander, Phil. Trans. 1767, and Experimental Essays, Lond. 1768.

[3] Ratier, Dict. de Méd. et de Chir. Prat. Paris, 1830, Art. Camphre.

In neuralgia, camphor is very frequently employed both internally and locally, but with no more than the very fickle benefit derivable from many other medicines. It is also sometimes used as a remedy for chronic rheumatism, and to assuage the pains of venereal nodes. It may be given internally in combination with opium, or the extracts of henbane, conium, or aconite ; and locally, may be applied by means of liniments or fumigations[2].

In acute gonorrhœa, camphor is very frequently resorted to in order to prevent painful erections and chordée. And its employment in these cases is an excellent illustration of the diversity of its effects in different doses, and the diversity of opinions regarding its value as a medicine. It is a well-established fact, that a large dose will often cause frequent and scalding micturition, and erections during sleep. Hence some authors have declared it to be positively injurious in gonorrhœa. On the other hand it is a matter of notoriety that it occasionally produces a perfectly opposite effect on the genitals. During the time that the cholera was prevalent at Paris, many persons wore camphor about their persons as a preventive, and continually breathed an atmosphere impregnated with it ; and it was a common complaint amongst those who did so, both males and females, that they lost both inclination and ability for carnal indulgences. M. Guersent also states that camphor refiners are very frequently impotent[3]. There is, therefore, no reason for doubting that it may be made to exert its antiaphrodisiac powers in gonorrhœa. For this purpose it may be given in doses of five grains at bed-time, combined with small doses of calomel, James's powder, nitre, or extract of henbane, according to circumstances.

Camphor is also of use in mitigating the spasmodic difficulty of micturition and pain at the neck of the bladder, which are sometimes caused by blisters of cantharides in young irritable subjects. But this accident is by no means so frequent as is sometimes represented ; and it may be got rid of by warm anodyne fomentations, and warm demulcent drinks, as well as by camphor. It used formerly to be sometimes administered internally, or sprinkled on blisters before their application, as a preventive of strangury, but this seems to be perfectly useless.

Camphor has also been found of some benefit in spasm of the œsophagus, and of the sphincter ani. In similar cases it may be administered internally, or in the form of enema, composed of one scruple of it, with six ounces of warm milk.

The uses of camphor as a topical remedy are exceedingly numerous. When applied to inflamed surfaces in a manner that permits of its evaporation, it acts as a refrigerant. A cerate formed by dissolving a scruple of camphor in an ounce of melted spermaceti ointment, is a popular and highly soothing application to slight burns, or to parts that have been rendered red and sore by exposure to sun or wind ; as well as to parts excoriated by friction or by the contact of irritating secretions. The *ceratum plumbi compositum* of the Pharmacopœia, an admirable defensative for excoriated surfaces, contains a small portion of it. Dissolved in oil, it is a favourite remedy with some surgeons for erysipelas. It is also sometimes mixed with flour, which forms a most soothing application in the last named malady.

The *Camphor mixture* of the Pharmacopœia is very often made the vehicle of other remedies in lotions, collyria, and gargles, but it contains so small a proportion of camphor that it can add but little to their efficacy. The corrosive sublimate renders it turbid.

Camphor is very commonly employed as a daily wash for the mouth, or as a toothpowder, in order to correct a flabby state of the gums, or unpleasant odour or taste in the secretions of the mouth ; and it is admirably adapted for this purpose, for when chewed, it almost invariably renders the tongue moist, and produces a considerable flow of saliva with a peculiar sweetish taste. Nor is this a matter of so little moment as a superficial thinker might deem it, for on the one hand the secretions of a foul mouth with rotten teeth are very apt to disorder the stomach, and ought, therefore, to be corrected and removed ; and on the other hand, if the secretions of the mouth are vitiated in consequence of disorder of the stomach, no one of any experience can doubt that by putting the mouth in a comfortable condition the appetite is improved, and a healthful disposition communicated to the succeeding portions of the alimentary canal.

In relaxed or ulcerated sore throat, or loss of voice, camphor is sometimes used as a stimulating gargle, which may be made by adding the *spiritus camphoræ* to water.

Camphor is a leading ingredient in many of the multifarious specifics for toothache. It may be used as a wash made with the camphorated spirit, as just described ; or may be made into a paste, with or without opium, by means of alcohol, to fill the cavities of carious teeth ; or its solution in alcohol, or oil of turpentine, may be used for the same purpose. M. Raspail, who seems to regard it as a kind of universal panacea, says that it is sufficient to place a fragment on the affected tooth, so that its vapour may surround it, to quell any toothache. In facial neuralgia and cynanche, the pain is occasionally assuaged by chewing camphor, or snuffing it up the nostrils, reduced to a very fine powder. In similar cases M. Raspail recommends it to be used as a cigar, a few lumps of it being enclosed in a tube of paper, through which the air is inspired[1].

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[1] Cassils, Ed. Méd. Journ. vol. viii. p. 123.

[2] Dupasquier, Rev. Méd. 1826, vol. ii. p. 218.

[3] Guersent, Dict. de Méd. Paris, 1834. Art. Camphre.

Reduced to a fine powder it is sometimes sprinkled thickly on the surface of indolent and sloughing ulcers, to excite their vitality, and to neutralize their noisome exhalations; but for either purpose it is much less efficient than many other substances. There are some cases of irritable ulcers, however, which require a frequent succession of mild stimulating applications, and which it might occasionally benefit.

It has been said to possess powers as a remedy for the itch, but every other substance with the least stimulating property, even brick-dust, has the same. It may, however, be occasionally of service as a palliative, if mixed with other remedies, to allay itching for a time. Some French surgeons combine it with all irritating applications in the treatment of skin disease.

It has been supposed to possess the faculty of diminishing excitement of the breasts, of moderating their vascular action, of retarding the secretion of milk, and consequently of preventing inflammation of the breasts in newly-delivered women. For this purpose it is sometimes administered internally, sometimes mixed with oil or yolk of egg, and applied by friction, and sometimes merely suspended in a bag between the breasts. In either case its efficacy is doubtful.

Dissolved in strong nitric acid it has been recommended as an application to recent wounds made whilst dissecting, and to other poisoned wounds, in order to destroy both the poison and the surface it was applied to, and so effectually to prevent it from contaminating the system. It has also been applied to phagedenic ulcers; but whether it can beneficially modify the virtues of the acid may be reasonably doubted.

Camphor acts as a slight stimulant to the skin when its evaporation is prevented. Thus the solution in alcohol or strong acetic acid applied to a part, and covered with oiled silk, produces considerable heat and redness, and relieves spasmodic or slight inflammatory pain. But either vehicle will do nearly as well without the camphor. The solution of camphor in vinegar is sometimes mixed with meal into a poultice for chronic inflammatory swellings.

Camphor is almost invariably combined with such liniments, ointments, and other external applications as are intended to assuage pain, excite absorption of thickening or deposits, remove stiffness, and produce slight irritation of the skin. Thus it enters into the composition of most of the liniments in the Pharmacopœia, and of the *ceratum hydragyri compositum*, the celebrated ointment of Scott for chronic affections of the joints.

Camphor seems to derive its extensive employment in medicine quite as much from its grateful odour as from its real virtues. It must be considered in most instances rather as an adjuvant than as the prominent ingredient in our prescriptions, and perhaps not its least valuable property is, that the patients are generally prepossessed in its favour, and convinced of its efficacy.

(*Robert Druitt.*)

CANCER (*καρκίνος*, *Gr.* literally a crab; *cancer*, Lat. idem; *cancer*, Fr.; *krebs*, *krebsgeschwür*, Ger.; *kreeftgezwel*, *kankergezwel*, Dutch; *kräfta*, *kräftskada*, Swed.; *cancro*, *canchero*, Ital.; *cancer*, *cancro*, Span.) The signification of the word Cancer has undergone several changes since its introduction into medical language. It appears to have been originally applied by the Romans to the conditions termed gangrene and sphacelus by the Greeks; while the term carcinoma was employed to designate the affection known by the moderns as cancer[1]: at a later period, however, authors used it as a synonym of carcinoma or carcinos (*καρκίνωμα*, *καρκίνος*.) It could serve no useful purpose to inquire whether the fanciful pathologists of early times fixed on this name for the disease, because they discovered a resemblance in the tumour and surrounding dilated veins to the body and claws of the crab; or because they actually believed that an animal devoured the ulcerating parts; or because, as some will have it, they simply wished to convey symbolically an idea of the loathsome character of the complaint: perhaps all three considerations influenced them in its selection. Whatever was the motive in thus naming it, the affection itself was at first presumed to be peculiar to the mamma; but in proportion as morbid states of similar character were found to occur in other parts, they were included under the same general title. Thus we find Paulus ab Æginâ defining cancer, a hard irregular tumour, with or without an ulcer, occurring in any part of the body, but most frequently in the mamma[2]. Early observers, struck forcibly by the difference of symptoms in the ulcerated and non-ulcerated stages of the disease, considered it expedient to mark this by a distinction of names; they accordingly restricted the application of the word cancer to the former state, that of scirrhus to the latter. By a further refinement the scirrhous stage was subdivided into two, the simply scirrhous, and the occult cancerous[1]; the supervention of pain being the signal for the change of name. More modern systematists, turning the word carcinoma from its true signification, distinguish it from cancer by limiting it to the painful scirrhus.

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[1] Raspail and Bellanger de Senlis. Bull. de Thérap. Jan. 1839, and Br. and F. Med. Rev. vol. vii. p. 549.

[1] Parr in voc.

[2] Lib. vi. cap. 45.

Further, the extreme similarity of some characters of the morbid product, now known as encephaloid, to those of carcinoma, led to the pretty general adoption of the term *soft cancer* for that disease; a new application of the word subsequently resisted by Abernethy and Mr. Wardrop on the grounds of the equally manifest differences subsisting between the two formations. In 1812, however, a distinguished French pathologist, Bayle, recognising more fully than his predecessors the fundamental similarity of soft and hard cancer, of encephaloid and scirrhus, without by any means underating the importance of their individual peculiarities, maintained the propriety of designating them by the same general name. Unfortunately he marred the excellence of his suggestion by including among cancerous diseases all cutaneous ulcerations of an intractable character: by thus grouping under the head cancer, affections essentially dissimilar, though agreeing in a single important particular, he contributed materially to engender the uncertainty even now prevailing in France regarding the application of the term.

To our countryman the late Dr. Young, therefore, belongs in reality the merit of having been the first to unite scirrhus (*carcinoma scirrhosum*) and encephaloid (*carcinoma spongiosum*) as species of a genus cancer or carcinoma. But his example has been very slowly followed. English writers, with the exception of Mr. Travers, more keenly perceptive of the differences than of the analogies of these products, have almost to the present day continued to define cancer as ulcerated scirrhus, and separate encephaloid completely therefrom under the title of fungus hæmatodes. Nevertheless opinion had been silently undergoing a change among us; we had been gradually learning to recognise the practical truth and importance of Dr. Young's nosological arrangement, when Dr. Carswell deprived us of all excuse for wavering by satisfactorily proving its justness.

But the researches of Laennec, Otto, Cruveilhier, and more recently of Müller, have distinctly established the close alliance of another morbid product, originally described by the first named of these pathologists under the title of colloid, to scirrhus and encephaloid: to this tissue, therefore, the generic term cancer, as we shall fully show, is equally applicable.

The union of these morbid structures into a distinct class is not a mere nosological artifice: it is manifest that the formations, to which we propose to apply the generic term cancer, possess characters entitling them to be grouped together and separated from all others to which the frame is exposed. They agree *anatomically*, for they are all composed of a containing and a contained part forming a combination without its counterpart in the natural structures; they agree *chemically*, for they are all distinguished by the vast predominance of albumen in their composition; they agree *physiologically*, for they all possess in themselves the power of growth and of extension by continuity of tissue, that is, of assimilating to their proper substance the most heterogeneous materials—an inherent tendency to destruction and the power of local reproduction; they agree *pathologically*, for they all tend to affect simultaneously or consecutively various organs in the body, and produce that depraved state of the constitution known as the cancerous cachexia. Their title to be united is quite as strong in respect of practical medicine and surgery, as in respect of scientific pathology, a consideration of the very highest importance. As respects the name to be given to the genus, cancer or carcinoma is clearly the best; to limit these terms to one particular tissue, when others possess the very properties on account of which they were originally employed, is a palpable contradiction.

Another doctrine, to which we shall refer elsewhere in the course of this article, has been advanced with regard to the degree of relationship subsisting between these adventitious formations. It is contended by some authors that although each of them acquires individual peculiarities with the progress of development, still they are primarily not merely allied growths, but actually one and the same morbid structure. Without inquiring, for the present, into the validity of this hypothesis, it will suffice to state here, that we shall describe them as distinct productions; and this because all observers who have examined them in their respective stages of full development—that is, when they possess their individual qualities in the highest degree—have noticed such general differences of appearance and of pathological characters, as to warrant such separation. It would be unprofitably trying the reader's patience to enumerate all the peculiarities, petty or important, in the opinions of Hodgkin, Carswell, Cruveilhier, and Müller, leading to a difference in the classification of carcinomatous tissues adopted by each. These peculiarities will gradually appear in the following pages, when they are of such importance, either practically or otherwise, as to demand attention. Without further preamble, therefore, we proceed to display tabularly the method according to which, as apparently best in accordance with the present state of knowledge, it is now proposed to treat of carcinoma in general.

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[1] Hippocrates.

Family.	Class.	Order.	Genus.	Species.	Varieties.	Synonyms of the Species.
Adventitious Formations.	Heterologous Formations.	Tissues.	Cancer or Carcinoma.	Encephaloid.	Common vascular sarcoma. } Abernethy. Mammary sarcoma? } Abernethy. Solanoid. Recamier, Zang. Nephroid. Idem. Napiform. Idem. Carcinoma fasciculatum vel hyalinum. Mueller. Fungus hæmatodes. Hey. Hæmatode Cancer. Auct. Gall.	Spongy or ossivorous tumour. Ruysch. Palletta. Struma fungosa (testis). Callisen. Spongoid inflammation. Burns. Milt-like tumour. Munro. Medullary sarcoma. Abernethy. Cerebriform disease or cancer. Laennec. Pulpy testicle. Baillie. Carcinus spongiosus. Good. Carcinoma spongiosum. Young. Fungoid disease. A. Cooper, Hodgkin. Medullary fungus. Maunoir, Chelius. Acute fungous tumour. C. Bell. Medullary cancer. Travers. Cephaloma. Hooper, Carswell. Carcinoma medullare. Mueller. Soft cancer. Auct. Var.
				Scirrhus.	Pancreatic sarcoma? Abernethy. Napiform, } Recamier. Chondroid, } Recamier. Lardaceous tissue. Auct. Gall. Carcinoma reticulare. Mueller.	Carcinomatous sarcoma. Abernethy. Carcinoma scirrhosum. Young. Scirrhous cancer. Travers. Scirrhoma. Carswell. Carcinoma simplex vel fibrosum. Mueller. Stone cancer. Auct. Var.
				Colloid.	Pultaceous cancer. } Cruveilhier Pearly alveolar ditto. } Cruveilhier	Areolar gelatiniform cancer. Cruveilhier. Carcinoma alveolare. Mueller. Gum cancer. Hodgkin.

It will be seen from this table that cancer is synonymous *anatomice* with adventitious heterologous tissue. The fact of its being a tissue, that is, of its possessing structure, separates it unequivocally as a morbid product from others belonging to the same class, for example pus and tubercle. The heterologous material of all carcinomatous formations is organizable, susceptible of vascular development, and hence of undergoing all the changes of increase and decay consequent on such susceptibility. The importance of this feature has been justly insisted on by several writers, but by none more pointedly than by M. Cruveilhier, who remarks, in his emphatic style, that cancerous products are living foreign bodies, which possess vital powers of their own, and, like the fœtus in utero, assimilate materials derived from the individual in whom they are developed, to their own peculiar substance. But in affirming that these growths enjoy a sort of independent existence, in styling them " true parasites and new individuals," this pathologist goes further than he is warranted by observation. An entozoon, however produced, lives without vascular connexion with the parent organism; it is almost needless to state that such is not the case with the class of products now under consideration.—Again, the heterologous character of carcinoma distinguishes it from another section of adventitious growths, the analogous, such as fatty, fibrous, and cartilaginous tumours. In thus applying the term heterologous, we refer to the general appearance of the mass, as seen with the naked eye; certain opinions of microscopical observers, which apparently clash with this use of the word, bear in reality upon a different point.

The genus carcinoma includes the three species already spoken of; and the term is meant to be equally applicable to them in every stage of their existence, before as after softening and ulceration. Each species presents a certain number of varieties. In a column apart are collected the chief synonyms, under which the species have been described by different writers. The comprehension of the works of these authors will, we trust, be facilitated by reference to this list; and the dismay naturally felt by the student on encountering in each new treatise one or more names of diseased formations seemingly distinct from all those he had previously become acquainted with, will be in some measure removed, when he discovers that such diversity of *names* by no means implies a corresponding multiplicity of *things*.

We shall divide the following article into two parts; devoting the first to the subject of cancer in general, in the second describing the disease as it occurs in those tissues and organs in which it is likely to come under the notice of the practical surgeon.

Part I.—Of Cancer in general.

§ I.—*Anatomy*.

(*a*.) Encephaloid (from ἐγκέφαλος, *the brain*, and εἶδος, *form*). The name of encephaloid or cerebriform tissue was first applied by Laennec to a modification of cancerous growth, of which one of the most striking characters is its resemblance to the substance of the brain. This resemblance has been noticed by almost all authors who have written on the subject, but Abernethy was the first, by his adoption of the term *medullary sarcoma*, to make it the basis of nomenclature. We employ the word encephaloid as more convenient and more commonly used.

The section of an encephaloid mass presents, when fully developed, the appearance of an almost homogeneous matter, of an opaque milky colour, ordinarily dotted with spots of pinkish hue, varying in different specimens in number, size, and shape. In consistence it closely resembles the healthy brain of an adult, and may be broken up between the fingers with about the same facility as the substance of that viscus ; if torn through, the lacerated surface presents a coarsely granular aspect. It has no particular smell ; Maunoir states that it has the same odour as the brain, but his senses were probably under the influence of the curious theory he maintained respecting its nature.

Tumours of this kind are found to consist essentially of two elements,—a contained part, the cancerous "matter," which gives the cerebriform appearance to the whole ; and a containing part, consisting of denser septa, which divide the mass into lobes and lobules. These septa rarely appear to intersect each other, but describe curves circumscribing lòculi of various shapes and sizes. Though occasionally of fibrous consistence, and in very rare instances even actually cartilaginiform, the laminæ composing them are ordinarily of very delicate cellular texture, and have in some cases been compared by observers to a spider's web.

It is unusual to meet with a tumour presenting these characters uniformly through its whole substance ; some portions are commonly harder, others much softer than the matter just described. The variation in point of consistence is marked by a difference in the mode of arrangement of the carcinomatous matter. The hardest part presents a radiated or firmly granular appearance ; that of less consistence is largely granular or lobulated ; while the softest is collected into large lobes of diffluent pulp. The quantity of pink spots and the opacity of the morbid matter generally increase with its softness. The facility with which the contained cancerous matter is removable from the containing loculi also depends on the consistence of the part examined ; when this possesses the density of infant brain, it may be removed by gentle pressure, or by letting a stream of water fall upon it, with as much ease as if enclosed in the cells of a sponge. The expressed matter sometimes preserves the shape of the loculi, and looks like fragments of boiled rice or vermicelli, and a filamentous shreddy locular tissue, the containing basis of the growth, is left behind. When sufficiently firm and adherent to resist this mode of separation, the carcinomatous matter may be removed either by maceration, or, as M. Cruveilhier has particularly shown, by cutting the mass into thin slices, and submitting them to the pressure of a machine.

The pink tint of encephaloid is evidently produced by the presence of numerous blood-vessels ; its abundant provision in this respect leads to the striking differences between the vital phenomena observable in it and in the other species of cancerous production. These vessels, which vary in diameter from that of a hair to a line and upwards, and appear to the naked eye to contain florid arterial blood, occur in the form of small isolated striæ in some situations, in others of arborescent patches. The *vascular* character is in some instances distinctly defined, in others ill-marked ; in the latter case the blood almost seems as if it had simply been laid on with a brush in minute points and striæ. Small rounded or irregular patches of effused blood are visible elsewhere.

This vascular supply is not limited to the dividing septa of the structure ; the vessels may be traced from the cellular substance investing the growth generally, or from the peduncle of a tumour when its attachment to the surrounding tissues is of this kind, seen to ramify into the septa, and from these to plunge into the contained matter. The latter frequently appears, on a section of the tumour, to be the part most abundantly furnished with vessels : in cases of very successful arterial injection the mass appears to be almost exclusively formed of a vascular plexus.

Besides the vessels communicating with external trunks, there are seen in the substance of encephaloid growths small vascular tufts, apparently unconnected with the surrounding circulation, assuming various shapes, of which the most common variety is a single minute trunk, terminating at either end by a number of ramusculi branching off in a stellate form. To these branches, more especially, the remark of Laennec, that the walls of the vessels of encephaloid are very thin in proportion to their calibre, may be understood to apply. Their venous or arterial character is a subject of dispute. According to Dr. Carswell they are frequently varicose, and have altogether much more a venous than an arterial aspect : to Dr. Hodgkin, they appear to consist of the capillary vessels of Bichat on a large scale, and their tendency to assume the arterial or venous quality chiefly determined by fortuitous circumstances : Cruveilhier authoritatively affirms that they are veins —an affirmation generalized in the statement, that arteries of new formation are never found in accidental tissues.

The general impression, however, derived either from the aspect of the vessels of encephaloid, or from the results of injection, appears to have been that they were essentially arterial. Until of late no particular inquiry had been made into the condition of the veins of these growths, pathologists being contented with ascertaining that the encephaloid matter may be frequently found in the larger veins on the surface of tumours and traced into the adjoining venous trunks. In 1830, however, Professor Bérard injected with all necessary care the arteries and veins of the neck of a subject who had died with two non-ulcerated encephaloid tumours in that region. On dividing the masses in different directions the usual characters of arterial injection were discovered; but the result as regards the veins was of a very different kind. The capsule investing the tumours presented a venous rete interlacing with that formed by the arteries in the same situation; but the closest search failed to detect a single venous ramuscule or even black point in the substance of the tumour. This failure could only be attributed to the total absence or impermeability of those vessels, for the venous capillaries of the neighbouring organs were admirably injected. Further examination explained this curious result by showing that the minute veins were completely obliterated with encephaloid matter. Whether the obstruction is in all cases so complete as in the instance referred to, is a point still open to inquiry; no experimental confirmation of M. Bérard's observation has yet been made public. This anatomist conceives that when such obliteration exists, it is atoned for by a supplementary venous circulation in the adjoining tissues. M. Cruveilhier believes that he has occasionally observed the arterial branches of gangrenous encephaloid blocked up with whitish matter.

Lymphatic vessels have not, so far as we are aware, been particularly noticed in encephaloid. Laennec presumes they do exist in it, from his having observed the adventitious tissue to acquire a yellow tint in an icteric subject; but the presence of lymphatic vessels is clearly not required to explain the circumstance. The only nervous filaments discoverable in this morbid growth are those of the tissues, amid which it is developed; these occasionally traverse its substance in different conditions, to be elsewhere referred to. Maunoir, misled by the physical and chemical characters of encephaloid, by the fact of its development in the tissue of the brain and nerves, and its similarity of constitution to the growths from, or protrusions of, the brain in cases of hernia cerebri, conceived that it was actually composed of effused nervous substance. This hypothesis does not require serious refutation.

Microscopical characters[1].—The inquiries of Valentin, Gluge and Müller on the microscopical elements of encephaloid have led to the establishment of the three following varieties in respect of its intimate constitution.

1. *Encephaloid characterized by predominant formation of medullary matter from roundish formative globules deposited beside the tender fibrous meshes intersecting the mass.*—To this class belong, according to Müller, the specimens described by Gluge. The globules observed by this inquirer were variable in size; the smallest measured $\frac{1}{123}$ of a millimeter in diameter[1]. Their form was irregular, but inclining to the circular; their surface uneven, and presenting points and blackish lines beside their transparent edges. Crystals were frequently detected in great numbers; some of them reaching $\frac{1}{8}$ of a millimeter in size: these were possibly, however, cadaveric products. Müller has himself found these globules very like those of ordinary scirrhus and of the gray fundamental basis of one of its varieties, reticular carcinoma. Some points or very minute granules are often discernible in the cavity of these globules; with strong magnifying powers a nucleus may frequently be detected in them, just as in the other forms of cancer. These appearances are shown in Pl. I. Figs. 1 and 2.

2. *Encephaloid with an extremely soft brain-like fundamental basis composed of pale elliptic corpuscules without caudate prolongation.* This variety would appear to be exceedingly rare, as Müller only met with it once in encephaloid of the tarsus. The corpuscules had very little connexion with each other, and constituted, together with vessels, almost the whole mass of the disease. They were from one and a half times to twice as large as the human blood globule. No filament was ever observed issuing from them, or nucleus or young cell in their interior; with an instrument of the strongest power one or more minute dark points only were detected. The aspect of these bodies is shown in Pl. I. Fig. 3.

3. *Encephaloid with caudate or spindle-shaped corpuscules.*—The fracture of specimens of this microscopical variety sometimes present an apparently fibrous aspect, when the caudate bodies follow fixed directions, as in the cases described by Valentin. Müller has seen them in several specimens, either isolated among the roundish formative globules already described, or in numbers, and forming the predominant element. According to the direction in which they are arranged, a radiated or tufted appearance is produced; if their arrangement be very irregular, the fibrous disposition is lost. These differences are exhibited in Pl. I. Figs. 4, 5, 6.

The cavity of these corpuscula contains either a granular body without a clearly distinguishable nucleus, or in other cases a nucleus with one or more nuclear corpuscules. The filamentous or caudal prolongation is observed either at one or both points of the ellipse, and is single or bifid; in some instances a third filament springs from its side. These appearances are seen in Pl. I. Fig. 7.

Chemical characters.—The chemical reactions of encephaloid, like its grosser physical characters, resemble those of the cerebral sub-

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[1] We trust the abridgment here given of Müller's descriptions will be rendered intelligible by the annexed copies of his engravings (Plates I. and II.:) some preliminary acquaintance with recent microscopical researches on the development of the ovum and embryonic tissues of animals will much facilitate their comprehension. The appearances detected by the microscope in each species of carcinoma, are stated under the head *Anatomy*; the theory of growth based on these appearances will be found in the section *Physiology*. An explanation of each figure will be found at the end of the article.

[1] The millimeter is =0·039370 of an English inch.

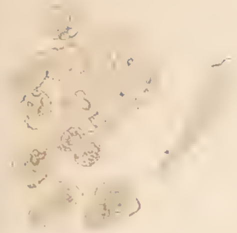
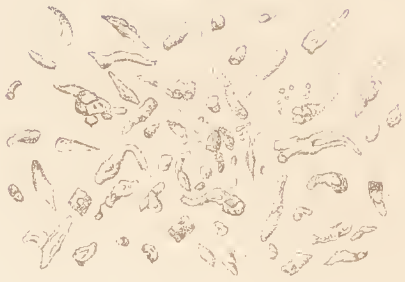


FIG. 2.

FIG



FIG

stance. Exposed to the action of the air, it gradually liquefies; it is miscible with water and hardens in alcohol and the acids. Lobstein relates some experiments by Hecht, undertaken with a view to establish its intimate composition: the chief result of these was, that gelatine entered very abundantly into the constitution of hard specimens, albumen into that of softened, while fat occurred in neither. Morin, Collard de Martigny, and Wiggers also agree in enumerating gelatine among the constituents of encephaloid: on the other hand, in the subjoined analysis of this morbid product by M. Foy, the most elaborate yet published, not a particle of that principle is noticed:—

Albumen		47·00
White fatty matter		7·50
Red do.		5·35
Osmazome		4·00
Fibrine		6·50
Water		8·00
Oxide of Iron		1·35
Subphosphate of Lime		6·30
Carbonates of	Soda	2·75
	Lime	4·00
	Magnesia	1·00
Hydrochlorates of	Potassa	2·70
	Soda	2·00
Tartrate of Soda		0·35

Maunoir had previously ascertained the absence of gelatine in this substance; and Müller, who divides all adventitious growths, in respect of their chemical composition, into three classes, the albuminous, the gelatinous, and the fatty, ranks cancerous formations with the first, and ascribes the occasional detection of gelatine by chemists to the association of cellular membrane with the matter analyzed. He affirms that, except in one case of encephaloid in the kidney, he never obtained any notable quantity of that principle, even after submitting the morbid matter to twenty-four hours' boiling. Casein was distinctly detected in the same organ. Wiggers discovered phosphuretted fat in this species of growth; Gugert biliary fat (Gallenfette) in a specimen occurring in the eye.

Form.—Encephaloid occurs as a distinct tumour, or is infiltrated into the tissue of organs. Such tumours are either *encysted* or *non-encysted.* The investing cyst, when such exists, is described by Laennec as a smooth membrane, about half a line thick, of a silvery white colour, imperfectly transparent, and easily separable from the enclosed mass. M. Cruveilhier refers to a well-marked case of encysted cancer of the liver: here a number of tumours, fluctuating precisely like abscesses, filled with encephaloid detritus of puriform consistence and bounded externally by fibrous cysts, were scattered through the substance of the organ; their cavity was traversed by vessels of various sizes, supported by fibrous tissue. The non-encysted variety is ordinarily spheroidal, but may be flat, oval, or perfectly irregular in shape. A sort of pseudo-cyst, varying in density with the situation of the tumour, is occasionally formed by condensation of the adjacent circular membrane. The cancerous growth may in these cases be enucleated with the greatest facility. Under this head may be included M. Cruveilhier's form of "disseminated masses," which, though occurring in various tissues, manifests a particular predilection for the liver: in this organ the number of the tumours of various sizes may range between one and several thousands.

The surface of encephaloid tumours is finely mammillated, botryoidal, or irregularly lobulated; in some instances convoluted like the exterior of the brain. In rare instances, when a true or false capsule exists, the periphery of the tumour is perfectly smooth. Superficial tumours of the liver occasionally present a remarkable cupular depression in their centre: this peculiarity has been attributed to the peritonæum adhering to the surface of the growth when small, and obstructing its central development. We have more than once seen a similar appearance in superficial encephaloid of the lung.

The colour of the exterior of cerebriform tumours varies with their state of vascularization; whitish yellow is perhaps the most usual tint, but it is not uncommon to find it either reddish, pink, or generally or partially bluish; all four colours may coexist in different quarters of the same surface.

The *infiltrated* or *diffused* form is that in which the adventitious matter is deposited in the interstices of a tissue, gradually transforming that tissue into a substance identical with itself. This form, very rare in some organs, as for example the testicle, is common in the liver, and is observed where the disease extends by continuity from one tissue to another.

Dr. Carswell's observations on the form in which carcinoma is deposited claim attention. In the earliest stage of the process of transformation, when the cancerous matter is first perceptible, it assumes, according to this pathologist, the form of the elementary physical constituents of the organ in which it occurs. This may be distinctly seen in the instance of the *acini* of the liver and of the fibre of muscle. In other organs, such as the lymphatic glands, brain, and testes, such arrangement of the adventitious substance is not traceable; but this is not owing to its absence, but to the colour, homogeneous aspect or minute structure of those parts rendering its detection difficult. At a more advanced stage of the disease the form derived from the structure of the affected part is lost; the shape of the carcinomatous growth is henceforth *tuberiform*, *stratiform*, or *ramiform*. Dr. Carswell has ingeniously shown the influence of extrinsic circumstances in determining these varieties of shape. But this influence is only occasional; for in some instances the form of a carcinomatous growth can only be explained by inequality of internal development: so, at least, it has appeared to us. When deposited in a situation where it undergoes equal pressure on all sides, the matter assumes a globular shape; when placed in circumstances which facilitate its lateral and obstruct its peripheric development, it acquires a fungiform figure, as is observed where the matter escapes from a dense into a soft tissue, or through an ulceration in the skin. *Stratiform* carcinomatous matter is chiefly met with in the subserous cellular membrane in layers of various extent and indefinite arrangement. It frequently appears in the form of small circular patches, varying in size from that of a pin's head to an inch or more in diameter, is in this state of a creamy consistence and most commonly met with under the pia mater and pleura pulmonaris. *Ramiform*, is the term used by Dr. Carswell to denote the arrangement of the adventitious matter in the veins, lymphatics, and lacteals.

Encephaloid growths acquire a larger *size* than almost any other morbid productions. Abernethy mentions the case of a patient who had a tumour of this description, as large as the head of an adult, in each groin. Such dimensions are by no means uncommonly met with, as the experience of large hospitals teaches. Professor Bérard observed an encephaloid tumour in the thigh of a female, as large as the body of a full grown man. Veins larger than the index finger ramified in the exceedingly attenuated integuments investing it. On the other hand, the opposite extreme of smallness is occasionally seen, and may be always detected when tumours are in the nascent state.

There is scarcely a tissue or organ in the body, in which encephaloid matter has not been observed, including in this proposition its development by extension from contiguous parts. Thus it presents itself in the cellular, the mucous, the serous, fibrous and synovial, the venous, arterial and lymphatic, the cutaneous, the gingival, the cartilaginous (costal and arytænoid cartilages), the fibro-cartilaginous (nares, pinna, epiglottis), and the ligamentous tissues. We have never observed this morbid matter in tendon or in the intervertebral tissue; but Mr. Travers speaks of its occurrence in the former structure. M. Littré presumes that the articular cartilages, in consequence of their supposed non-vascular character[1], are exempt from the disease; he probably means from its primary development. We have not met any distinct example of the transformation of these cartilages, however, or of the synovial membranes or bursæ[2]. In the osseous tissue encephaloid forms one of the varieties of osteosarcoma; the medullary substance, of the brain frequently, of the nerves more rarely, contains growths of this description; as do also the muscles of voluntary motion, the heart and involuntary muscular tissues generally. Among the viscera it will be sufficient to notice the liver, vesicula fellis and ducts, spleen, pancreas, kidneys, lungs and bronchi, stomach and intestines, uterus, ovaries, Fallopian tubes, testicles, prostate, and bladder, as the observed seats of this species of carcinoma.

These tissues and organs are not all equally disposed to become the seat of encephaloid growth: the common cellular membrane, the testicle, the liver, and stomach, are perhaps distinguished by the frequency with which this species of cancer originates in them. Particular parts of organs, also, are more liable to be attacked than others: different pathologists have observed that in encephaloid of the stomach, liver, uterus and vagina, the pyloric region, the surface and vicinity of the sulcus umbilicalis, the cervix and the anterior wall are respectively most prone to the morbid transformation. Dr. Carswell remarks that of the tract of small intestine, the duodenum and commencement of the jejunum are perhaps alone subject to the affection; and that in the large intestine it is exclusively confined, when primary, to the sigmoid flexure and ileo-cæcal valve: but the rectum furnishes an obvious exception to the latter statement. Double organs are not often simultaneously affected.

The nature of the tissue in which the cerebriform *mass* originates, affects, in some instances, the phenomena of its growth and composition. Thus when the disease springs from bone, it is not unusual to find mammillary osseous vegetations, spiculæ, or lamellæ projecting from the normal tissue into the heterologous formation: these sometimes constitute a solid stroma for its deposition. The cancerous *matter* is not, however, in these cases altered in nature or properties.

Parts in a state of chronic induration are not exempt from the occurrence of cancerous infiltration. The inodular tissue of cicatrices following the removal of carcinoma, and, as it would appear from a few well authenticated facts, pseudo-membranes formed on the free surface of serous tissues, are likewise capable either of undergoing encephaloid transformation, or of forming the basis, whence fungating growths of this character may spring. Among accidental productions, erectile tumours (nævus maternus, aneurism by anastomosis, &c.), are peculiarly prone to become the seat of encephaloid formation; hence, no doubt, arose the confusion that long prevailed, particularly in France, in the application of Hey's term, fungus hæmatodes; it was indifferently used in speaking of fungating encephaloid and the disease now referred to. By Dr. Hodgkin this striking feature in the pathology of adventitious erectile tissues, is ascribed to their low vitality; by Walther and Recamier to persistent irritation from internal and external causes: both notions are purely hypothetical.

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[1] For a luminous discussion of the question of the vascularity of articular cartilage, we beg to refer to the article ARTICULATIONS. Some further observations have been recently made on the subject by two Dutch experimentalists, Professor Sebastian and Dr. Schumer. See Brit. and For. Medical Review, vol. vii. p. 535.

[2] In the elaborate essay recently published by Bielkiewicz on the anatomy and pathology of the tho subcutaneous bursæ, no mention is made of carcinomatous disease of these structures. See L'Expérience, Nos. 108, 113, 115, 1839, for a notice of this author's treatise.

Multilocular cysts, as observed in the ovary and mamma, frequently contain in some part of their walls encephaloid vegetations, or masses.

Certain adventitious structures have been declared incapable of becoming the seat of carcinoma. Bayle and Lobstein affirm that fibrous tumours are thus characterized: Dupuytren formally denies the correctness of their opinion. See Fibrous Tumours.

The number of parts affected in one subject varies very considerably: though it is comparatively rare to find this species of cancer limited to a single organ, more especially if the disease have been in existence for any length of time before death, yet such occurrence is by no means unestablished by experience. In other cases a vast number of organs, and in every conceivable variety of combination, are found to be the seat of the disease. M. Velpeau's celebrated case supplies the most marked illustration of multiple development with which we are acquainted: in this instance the common cellular membrane, the muscles and bones, the lungs and heart, the tissue between the costal pleura and ribs, the stomach, duodenum, and small intestines, the pancreas, kidneys, liver, vena cava, and coats of the gall-bladder, the peritonæum, dura mater, and the thyroid gland, were all in various degrees affected with the disease.

Varieties.—Under the title of *common vascular sarcoma*, Abernethy included "such tumours as are organized throughout, but without any distinguishable peculiarity of structure." The description given of these tumours is vague enough, yet sufficiently clear to show that lobulated encephaloid, firm and unsoftened, was probably the structure which our great surgeon had in view.

The tumour designated by the same observer, as *mastoid or mammary sarcoma*, is still more difficult of identification; Dr. Carswell however, considers the term to refer to cases in which the carcinomatous substance is uniformly disseminated through the texture of an organ.

M. Recamier gives the names of *solanoid* and *nephroid* to hard, scarcely elastic encephaloid, possessing the appearance of a section of a potato or the kidney. The justness of this comparison may frequently be seen[1]. When the fibrous intersections are distinct, broad and fascicular, the divided mass has more the appearance of a cut turnip, and is therefore called *napiform* by this pathologist. This latter condition is, however, much more frequent in true fibrous tumours.

Under the name of *carcinoma fasciculatum vel hyalinum*, Müller describes that rare form of encephaloid in which a fibrous or linear arrangement coexists with softness. Tumours of this description tear in the direction of the fibres; in this differing from common encephaloid. They are frequently, nevertheless, lobulated externally and internally, and are sometimes transparent like jelly. The fibres follow no fixed arrangement; they are usually pale and transparent, whence the term *hyalinus*, vitreous. This is not a constant character however. Examined under the microscope, this growth presents neither the cell-globules of the other sorts of carcinoma, nor the caudate corpuscules of apparently fibrous encephaloid. From the transparency of the fibres under the instrument, they require to be examined in deep shadow; their surface is studded with granules. The character of the fibre is seen in Pl. I. Fig. 8. It is probable, according to Müller, that this variety is nothing more than carcinoma reticulare (a form of scirrhus to be presently described) in a soft condition. It seems allied to the nephroid cancer of Recamier.

There are two conditions under which the relation of the encephaloid matter to its vessels or their contents is productive of appearances which have led to the application of particular names to the disease. 1. When interstitial hæmorrhage leads to sanguineous infiltration of the mass or irregular accumulations of blood, and when, especially after ulceration of the integuments, a rapid development of fungating growths takes place from its substance, the disease, in imitation of one of its earliest describers, Hey, is termed *fungus hæmatodes*. The circumstances under which this name is applicable are, however, merely fortuitous, and do not imply any fundamental distinction in the nature of the growth exhibiting them. If (inasmuch as the changes to which it refers materially affect the local and general pathological influence of the morbid formation) this name be retained for practical purposes, it should be strictly limited to the disease when in the state described: as a general term for the species, it is strongly objectionable; nor, strictly speaking, can fungus hæmatodes be considered a variety. 2. This term has also been applied in cases where an abundant vascular and erectile rete forms a striking constituent of the growth (Dupuytren); but this state is by some designated as *hæmatode cancer*.

(*b.*) Scirrhus. (From *σκίῤῥος*, which from *σκίρος*, a piece of marble.) Galen used the term scirrhus as a synonym of *σκλήρωμα*, hardness; and it appears to have been applied by him and his successors to all tumours possessing this character. At an early period, however, it was limited to diseased induration, of which the essential peculiarity is to terminate in intractable ulceration. It is hardly necessary to add, that it is here used in the latter acceptation[1].

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[1] Tumours of the *solanoid* description have sometimes a fatty unctuous look on division, and are almost perfectly homogeneous, (neither fibre nor vessel being usually visible with the naked eye,) and of light yellowish colour.

[1] In this sense we also use the adjective *scirrhous*. Probably the mal-application of no single word has led to more serious confusion than of this adjective, which is by many writers applied indiscriminately to all *hard* structures, though they rigidly confine their use of the substantive to a particular form of carcinoma.

If a section be made of a scirrhous tumour while in the stage of induration, the existence of a containing and contained part is immediately recognised. The general colour of the cut surface, or, more correctly speaking, of that portion of it formed by the contained element is grayish, or bluish white, in rare instances greenish, reddish, or deep-brown, but under all circumstances presenting a glossy and peculiar semi-transparent aspect: the latter character is best seen by examining a thin slice of the substance. The containing tissue, formed of bands of fibrous appearance, which are easily distinguishable from the matter they enclose by their greater opacity and their inferior glossiness, vary considerably in their mode of arrangement. In some instances they form spheroidal cells; in others a rectilinear disposition predominates; in others they appear to radiate from a central fibro-cartilaginous nucleus to the periphery of the tumour. The proportion of surface occupied by the cancerous matter and the intersecting lamellæ varies greatly. The former is commonly most abundant, the septa constituting simply delicate partitions; but in the early stage of the disease, especially in dense organs, a firm, pale, compact, cellulo-fibrous tissue (chondroid of Recamier) is not unfrequently, as Dr. Carswell observes, the only anatomical element to be distinguished: there is now no distinct appearance of septa; but as the disease advances, the secretion of true cancerous juice grows proportionally active, and the locular character is developed. The septa of scirrhus frequently stretch beyond the tumour into the surrounding cellular tissue.

One of the chief characteristics of this species of carcinoma is its extreme hardness; in this respect it often exceeds cartilage, and there is hardly any exaggeration in the vulgar term stone cancer. As a general measure of consistence, the intervertebral fibro-cartilages are perhaps the best. The degree of induration in the actually hard part of a tumour is very equal throughout; but there are frequently scattered through its substance one or more small masses of homogeneous pulpy matter, of yellowish brown colour, semi-transparent, slightly glutinous, and altogether closely resembling apple-juice. The transition from hardness to complete pulpiness is usually sudden, the stratum immediately adjoining the softened matter possessing the full share of density existing elsewhere. The degree of adhesion of the enclosed matter to the fibrous septa, though variable, is always considerable. By forcible pressure a thin albuminous fluid may be made to exude from a slice of the tumour; this is the scirrhous juice or ichor. The importance of its presence as a diagnostic sign of scirrhus is indubitable; M. Cruveilhier goes so far as to affirm that it forms the only distinction (visible with the naked eye) between some tumours in the bones really belonging to this class, and others merely fibrous.

It is commonly impossible to discover with the naked eye any vascularity in an uninjected scirrhous mass. Delpech is stated, as something extraordinary, to have shown some capillaries running a few lines into a tumour. Scarpa even affirms that no matter how fine material be employed for injection, none can be forced into the morbid growth itself—that the principal arterial trunks of the diseased organ only are filled. Mr. Travers and Lobstein write in a similar strain. Dr. Carswell states that blood-vessels are rarely perceptible; and that such as are discoverable really belong to the normal tissues enclosed within the heterologous substance. Cruveilhier on the other hand maintains, that, in spite of this tenuity, vessels may be recognised with a little attention; while Müller expresses his astonishment that authors should have represented this structure to be without them, and declares he has never failed to discover them on accurate examination. Independently of *à priori* views, we are disposed to agree with the last named observers from our own experience: we have occasionally seen injected specimens of undoubted scirrhus, in which an obscure rosy tint from abundant punctuation was plainly perceivable.

No attempt has, so far as we are aware, been made to investigate the relations of the venous, lymphatic, and nervous systems to these tumours.

Microscopical characters.—Passing over the observations of Everard Home on this subject, which are too fanciful to require particular notice, we come to the recent inquiries of Müller. In some specimens of scirrhus of the mamma examined by this anatomist, white canaliculated filaments containing a colourless, whitish, or yellowish matter, were seen scattered through the mass. These hollow filaments appear to consist of lactiferous ducts and lymphatic vessels with thickened walls; they are not found in non-glandular parts. They are represented in Pl. I. Fig. 9.

The mass of the scirrhus consists of a fibrous and a granular substance. The former constitutes the bed in which the latter is deposited, and cannot generally be distinguished until the granular element has been scraped away or removed by maceration; it then exhibits the appearance seen in Pl. I. Fig. 10. The remaining matter, of gray colour, consists of loosely-connected microscopical formative globules, or transparent hollow cells or vesicles measuring from ·00045 to ·0012 of a Paris inch in diameter, and insoluble in cold or boiling water, and in acetic acid. In many of these cells some points resembling minute granules are alone to be recognised, (Pl. I. Fig. 11. and Pl. II. Fig. 1.); in others one or more good sized corpuscules, like nuclei or smaller vesicles, are perceived, and each of these corpuscules or germinal cells is itself supplied with a minute opaque nucleus, as is seen in Pl. II. Fig. 2.

Chemical characters.—Morin, Collard de Martigny, and Hecht, have examined the

FIG. 1

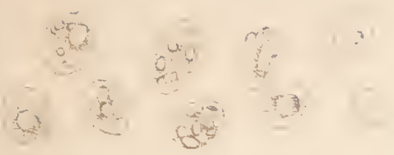


FIG. 2

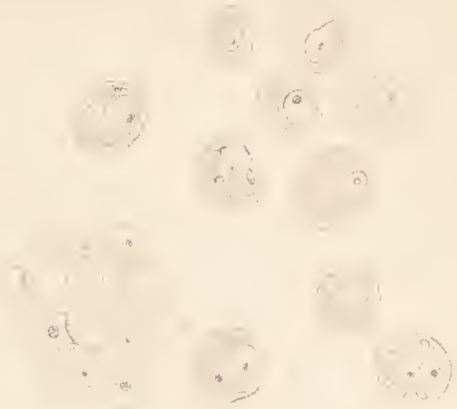


FIG. 4

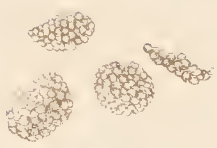


FIG. 3

FIG. 5

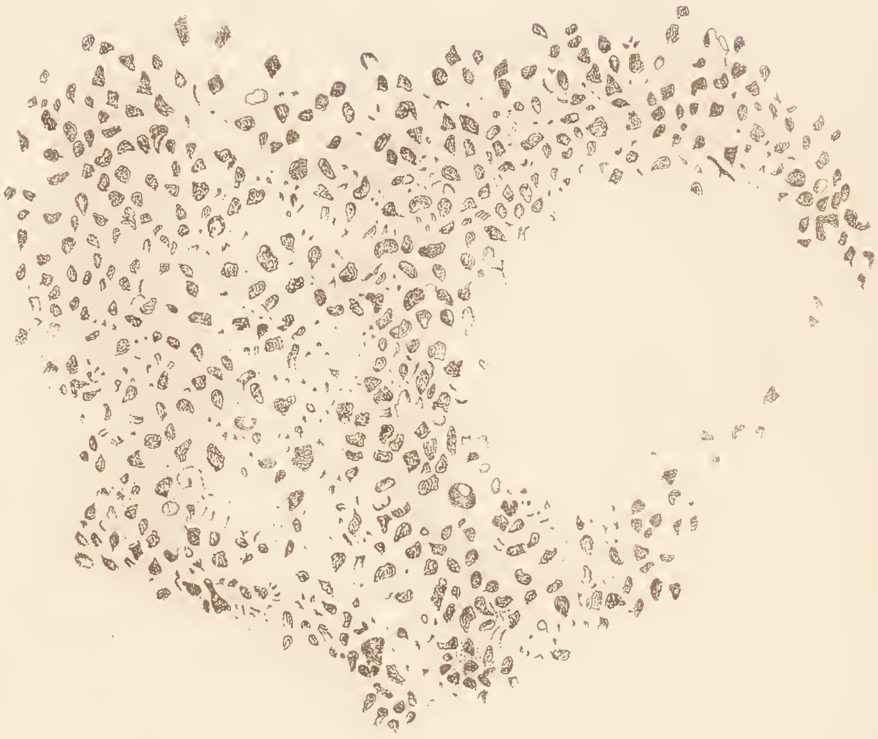


FIG. 6

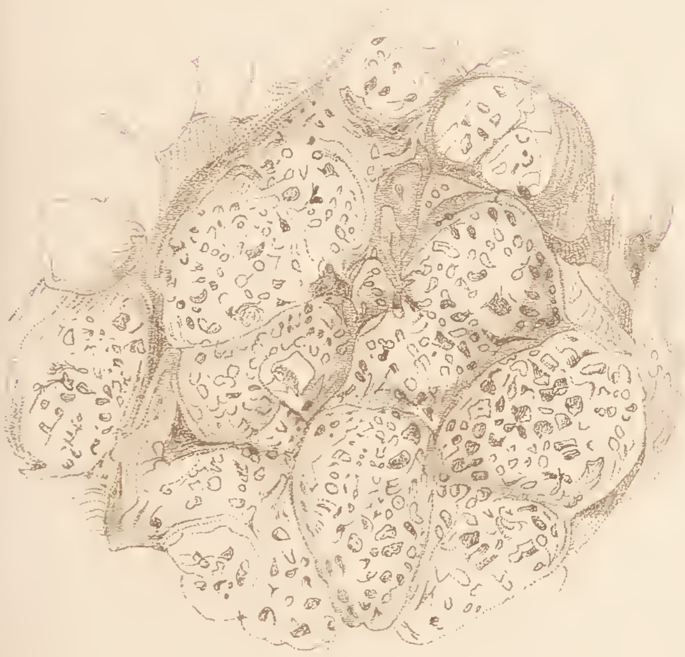


FIG. 7

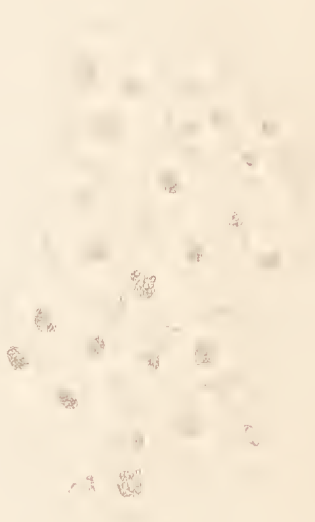
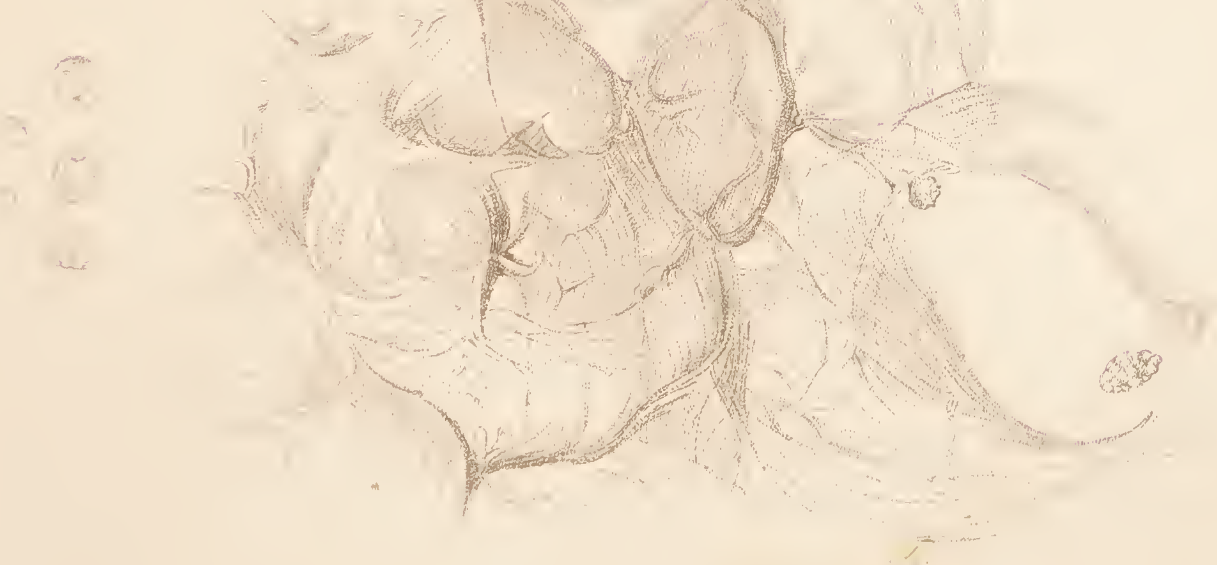


FIG. 8



chemical constitution of scirrhus, and the two latter chemists published quantitative analyses of some specimens. All three agree in enumerating gelatine among its elementary principles. The following analysis is by Foy :—

Albumen		42·00
White fatty matter		5·00
Red ditto		3·25
Fibrine		5·85
Water		5·00
Oxide of Iron		1·65
Subphosphate of Lime		16·60
Carbonates of	Soda	5·00
	Lime	6·60
	Magnesia	0·85
Hydrochlorates of	Potassa	4·10
	Soda	3·25
Tartrate of Soda		0·85

Compared with the analysis of encephaloid by the same chemist, the chief peculiarities here are the less quantity of albumen and fibrine, the absence of osmazome, and the much higher proportion of inorganic salts : no gelatine occurs in either case. Müller's observations confirm their accuracy in this latter particular : after repeated examinations of mammary scirrhi, and boiling them for 18 or 24 hours, he only succeeded once in detecting gelatine. Casein he discovered in the reticular variety, and considers it a very uniform constituent of carcinoma of the breast ; but that its presence in this gland does not depend on the contents of the remaining fragments of the lactiferous ducts is shown by its entering into the composition of the disease in other organs.

Scirrhus is either developed in the form of a tumour or is infiltrated in the substance of organs. Scirrhous tumours are usually rounded or oval, and flattened ; their external surface smooth in the outset, lobulated and anfractuous in the more advanced stages. The latter disposition is most strongly marked, when the disease has originated in a single point ; the former when the total mass is composed of several minor growths. We have never observed them invested with a true cyst ; the statements of Dupuytren, Recamier, and others, seem, however, to be conclusive of its occasional existence. The infiltrated form is not unusually met with in some organs. Of five cases of cancer of the brain described by Andral[1], two were of infiltrated scirrhus. In the uterus this mode of deposition of the carcinomatous matter is much the more common ; it attacks the bones too, in them gradually producing softening, while it indurates the soft parts—a striking illustration of the assimilative power of the morbid growth : in each instance it alters the consistence of the part to its own standard.

Scirrhous tumours very rarely, if ever, acquire large dimensions ; they seldom exceed an orange in size. This character helps to distinguish them from fibrous growths.

Scarpa believed that scirrhus is never produced primitively in any other situation than the external conglomerate glands, in the skin, and in certain viscera invested by the mucous membrane. With the first class he ranks the mamma, the parotid gland, the testicle, the submaxillary, and lachrymal glands ; with the second the œsophagus, the rectum, the vagina, the neck of the uterus, and the larynx. He maintained that scirrhus never occurs primitively in the lymphatic vessels or glands, in the sublingual glands or tonsils, or in such viscera, properly so called, as have not been included in the enumeration just made, although some of them are invested with a mucous membrane. Numerous English authors write, though less definitely, to very much the same effect. Mr. Travers limits the occurrence of scirrhus " to some or other description of secretory texture." But the more recent investigations of accurate observers at home and abroad (Velpeau, Hodgkin, Carswell, Cruveilhier, &c.) have proved the error of such doctrines. Cancerous tissue, possessing all the characters of scirrhus, occurs in the bones, the voluntary muscles, the liver, the lungs, the brain, and has been met with in the substance of the heart. On the whole the seat of this species of carcinoma appears scarcely more limited than that of encephaloid.

Scirrhus is ordinarily solitary ; in some instances, however, growths of this species have been observed in several organs in the same subject. The female mamma, the uterus, the stomach, and the lower lip are the parts of the body most frequently attacked.

Varieties.—The *pancreatic sarcoma* of Abernethy is set down as a variety of scirrhus by Dr. Carswell, the peculiar appearance resembling the tissue of the pancreas being ascribed to a lobulated arrangement of the scirrhous matter : by Dr. Hodgkin it is supposed to refer to " non-malignant tumours composed of compound serous cysts :" according to Chelius the pancreatiform and mastoid tissues are nothing more than accidental modifications of encephaloid : Professor Bérard, after a diligent study of Abernethy's essay, declares himself unable to determine to what description of structure the term was applied. Our own conclusion on the subject agrees with that of the latter writer. Abernethy refers to a tumour, possessing vessels, 7½ inches in length, 3½ in circumference, weighing two pounds and a half, and developed under the ocular conjunctiva, as an example of pancreatic formation ; now the seat, bulk, and other characters of this mass appear tolerably strong evidence that it was not of true scirrhous nature. Müller speaks of an encephaloid tumour of which the innumerable small component lobules gave the mass a pancreatic appearance ; some of Cruveilhier's figures of pultaceous areolar carcinoma bear no distant resemblance to the structure of that viscus : as far as our experience goes, the term is more applicable to either of these species of cancer than to scirrhus.

M. Recamier terms this morbid formation

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[1] Clinique Médicale, t. v. p. 633. et seq.

in its earliest stage *chondroid;* the consistence of the substance is then very closely that of cartilage, its section shining, and of blueish-white colour.

In perusing the works of French pathologists much difficulty is felt in determining to what growths they apply the phrase *lardaceous tissue*, or rather the conviction arises that they thus designate all morbid productions of every class possessing an accidental resemblance to the boiled rind of bacon. Now scirrhus, when infiltrated in the substance of organs, frequently assumes this appearance. In this manner Andral speaks of the tissue of the brain being "transformed into a lardaceous tissue possessing all the characters of scirrhus." The term is a useless addition to our already over-loaded nomenclature.

Under the title of *carcinoma reticulare* Müller describes that form of scirrhus in which a reticulated appearance of the fibrous intersections is particularly manifest. This condition of the septa announces, according to Müller, other peculiarities in the scirrhous growth. Tumours of this description attain a larger size and have a greater tendency to lobular arrangement than simple scirrhus; their consistence ranges between that of ordinary scirrhus and encephaloid. The greater number of cancers of the female mamma are of this description; Müller has also seen it in the stomach, axillary glands, lip, orbit, anterior mediastinum, and in small masses on the surface of the heart. So far we can perceive nothing really novel in the description of carcinoma reticulare; its microscopical characters, however, appear peculiar. It consists fundamentally of a grey globular matter, embedded in meshes formed of fibrous fasciculi, which are represented in Pl. II. Fig. 3, as they appear after the removal of the globules. Its globular structure seems the same as in ordinary scirrhus, the globules containing subcells, nuclei, or granules; minute unattached granules are occasionally seen in great numbers between the vesicles, the smallest of them endowed with molecular movement. The cell-globules measure ·00021 to ·00040 of a Paris inch in diameter. The reticulated figures are not formed of enlarged vessels with thickened walls, as is occasionally seen in simple scirrhus, but produced by the inlaying of white granules in the grey mass. These granules are not cellular, but apparently formed of an accumulation of opaque sub-granules. Their appearance under a magnifying power of 450 diameters is shown in Pl. II. Fig. 4. They are generally roundish or oval, and from twice to four times as large as the globules of the blood. Their mode of arrangement producing the reticulated figures is shown in Pl. II. Fig. 5: they are magnified 100 times and seen by transmitted light.

(*c.*) Colloid. This term, derived from κολλώδης (from *κόλλη*, *glue*, and *εἶδος*, *form*,) was first applied by Laennec to a heterologous product, one of the most striking peculiarities of which consists in the gelatiniform character of its contained element. A tolerably accurate description of this morbid product was also given in 1816 by Otto, and an illustrative engraving in his "Beobachtungen" conveys, though in a rough manner, its characteristic features: the disease, which occurred in the stomach, was described as scirrhus of that organ.

The section of a colloid growth presents an appearance, which once seen can scarcely be forgotten. The surface is divided into a vast number of distinct alveoli regularly arranged, of an oval or rounded shape, varying in size from that of a grain of sand to the largest pea. The septa composing the walls of these loculi possess distinctly fibrous characters; their thickness is pretty uniform throughout, occasionally, however, they are broader in some situations than in others; in this case the thicker septa may generally be found to give off productions forming the walls of secondary loculi, and these again others, constituting a tertiary order. The loculi sometimes form shut sacs, in other instances communicate with the circumjacent cells; it is not very unusual to observe alveoli of which the walls seem to have collapsed and coalesced from the removal of the contained matter. In point of consistence a colloid mass, of which the loculi are perfect, usually resembles firm cheese, but may be much harder; the general colour of the divided surface is greenish yellow. The latter is more especially the case with the contained matter, which is, besides, semi-transparent, tenacious, and clammy, and resembles in respect of density, as in other physical properties, soft jelly. It is not easily expressible from the containing loculi, but may be picked out with the point of a scalpel, or removed by maceration.

A remarkable character of this structure, so long as the process of destruction has not set in, is, that wherever or in whatever form it be developed, the appearance and properties of its constituent elements are exceedingly uniform in every part of its surface; the firmness, transparency, and other qualities of the tissue are as distinctly marked towards the centre as the periphery of the mass. The peculiar uniformity which sometimes exists in the size of the alveoli is well shown in a figure of the disease as occurring in the cranial bones and pituitary membrane, copied from Cruveilhier's twenty-first Fasciculus.—(See *Cancer of the Meninges.*)

In a specimen of the disease affecting the stomach, we recently noticed the following particulars:—The morbid matter occupied about one-third of the posterior surface of the organ, terminating at about half-an-inch from the pylorus, and formed an irregular globular elevation somewhat more than half-an-inch high (exclusive of the coats of the stomach), two broad, and two and a half wide. Over by far the greater part of its surface, which was irregularly mammillated, and of a greenish yellow tint, the morbid matter was uncovered, and exhibited its characteristic alveolar and jellylike aspect. But on the confines these characters were only seen in some spots, where destruction of the investing mucous membrane had taken place: this destruction seemed to consist in a simple wearing out from gradual attenuation; there was no hardening or elevation of the borders of the small perforations thus produced, nor had they the appearance of ordinary ulcers. Surrounding this mass, on its cardiac border, was an elevated flabby formation, more than half an inch high, and three lines thick in some places, with the feel of a piece of lung condensed by simple pressure. On making a section of this production, the colloid tumour and the coats of the stomach, the following were found to be their condition and mode of relation. The peritonæum was everywhere traceable, and in some parts considerably thickened; the muscular tunic, of a pale yellow-green tint, varied from one-eighth to a quarter of an inch in thickness: the major part of the colloid mass lay on the gastric surface of the cellulo-fibrous membrane, to which it adhered closely; in one or two points of its periphery the diseased structure penetrated, as it were, through this membrane and the muscular coat down to the peritonæum, along the inner surface of which it then spread for about half an inch. Where the mucous membrane existed entire over the colloid structure, it could be dissected from off the latter without injuring the cancerous cells—a fact showing that the morbid matter was here developed between the cellulo-fibrous and the mucous tunics. But the colloid alveoli also extended, gradually decreasing in closeness and number, into the elevated production already referred to: this seemed itself to be nothing more than a hypertrophous state of a fold of the mucous coat, accompanied with flabby induration; it had neither the structure nor the consistence of any form of indurated carcinoma, and its gastric surface was perfectly sound and apparently healthy. Hence it appears that the mucous membrane, previously rendered hypertrophous, may, as well as the cellulo-fibrous and mucous tunics, become the nidus of the diseased formation. M. Cruveilhier has made a closely similar observation, for he remarks that the fungous vegetations, observed in the substance, or on the confines of gastric colloid, are mucous papillæ prodigiously enlarged. According to Müller the development of the gelatinous cells is coeval between the fasciculi of muscular fibres and in the mucous tunic: in the earliest stage of the disease the cells are only visible with the aid of the microscope.

Little has yet been done in investigating the vascular condition of colloid. Cruveilhier says that both arteries and lymphatics in a permeable and healthy state are found between the alveoli of the diseased mass; the cells he considers formed of dilated veins. When the disease has reached its maximum development, no trace of vessels is, according to the same observer, discoverable. Müller speaks of a case in which the cells were invested with a distinct vascular membrane, but is silent respecting the character and mode of distribution of the vessels. Velpeau injected a colloid tumour of the shoulder before removal from the body, and observed vessels, "presenting nothing remarkable," in its septa. Andral is not aware that vascular twigs have ever been traced into the jellylike matter itself.

Microscopical characters.—According to Müller, when the minute cells of colloid structure are examined under the microscope, they are observed to contain several more minute cells enclosed within them, and again these secondary cells a tertiary order of still smaller dimensions. An opaque yellow parietal nucleus is easily seen in the smaller cells; and many of the latter also contain free nuclei in their interior, as cytoblasts[1] for the development of future cells. (Pl. II. Figs. 6 and 7.) The largest cells have distinctly fibrous walls, and the fibres pass from one cell to another, as is seen in Pl. II. Fig. 8. Müller observed, in two instances, acicular crystals in the jelly of preparations preserved in alcohol; and in one case caudate bodies similarly situated. In order to distinguish the encasement (*einschachtelung*) of the cells and their relation to the nuclei, it is necessary to examine the disease in the earliest stage of development.

Chemical characters.—The jellylike matter of colloid retains its transparency in preparations preserved in spirits of wine. Müller was unable to discover any trace of gelatine in the expressed jelly, when carefully freed from membranous tissue. A tumour, removed from alcohol, was boiled for eighteen hours, and at the end of that time had only yielded a very small quantity of matter, which though somewhat allied in properties to the salivary principle, was in truth *sui generis*, and could not be precipitated by any reagent, not even by tannin: its existence was established by evaporation of the fluid in which the mass had been boiled. When tumours, which have been long kept in spirits, are operated on, they are found free from osmazome; this principle must be first carefully removed, when fresh specimens are made the subject of analysis. No casein is found in the jellylike matter. Cruveilhier likewise ascertained that the contained matter yielded albumen only in the ordinary specimens of the disease; but in the remarkable instance of the pultaceous variety already referred to, the contents of the cells, submitted to analysis by M. Boutin-Limousineau, were ascertained to consist of casein.

Colloid presents itself as a distinct solitary tumour, or in numerous small masses disseminated through the substance of an organ, or the morbid matter is infiltrated in the tissues affected. When occurring in the form of a *tumour*, it is sometimes surrounded with a pseudo-capsule consisting of condensed cellular tissue, in some cases of such tenuity that the character of the subjacent substance may be partly distinguished through it. The external surface is lobulated. *Disseminated masses* of colloid structure are met with in the greater and lesser omentum, as an extension of the disease from the stomach; they vary in size from mere granulations to tumours of moderate size; two or more occasionally coalesce into a single mass. The *infiltrated* form is of most common occurrence in the stomach, and is likewise met with in the omentum. The former viscus retains its natural shape when thus affected, though its cavity is much diminished in size from the occasionally extreme thickening of its walls: when the latter condition is carried to its greatest extent, the organ does not collapse when removed from the abdomen.

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[1] From κύτος, a cell, and βλαστός, a germ.

Colloid growths acquire considerable bulk: there is a formation of this species as large as a cocoa-nut, and connected with the omentum, among the preparations in the collection at King's College. In the infiltrated state it sometimes extends over upwards of two-thirds of the anterior and posterior surfaces of the stomach, as in Otto's case; according to Cruveilhier, in a good proportion of instances of destruction of the entire surface of that viscus, the disease exhibits the present form of structure. Velpeau has seen masses, weighing several pounds, in the extremities.

According to Cruveilhier, colloid is the form of cancer most frequently met with in the diseased condition of the bones termed osteo-sarcoma and spina-ventosa: he has, besides, observed it in the uterus, ovary (?), at the lower extremity of the rectum, in the cæcum, the small intestine, and the omentum. It has, however, appeared to him (and here his experience coincides with that of other observers) to occur most commonly in the stomach, and, like other cancerous structures, to affect, more particularly, the pyloric region. The specimens of this species of carcinoma which have fallen under the notice of Dr. Hodgkin were all situated in the abdomen, either attached to or seated at no great distance from the alimentary canal, and usually in the neighbourhood of the stomach and rectum. This pathologist, however, further informs us that it is not very uncommon in connexion with tendon or bone. He endeavours to explain the predilection the disease appears to affect for the alimentary canal, on the principle that the products of the disturbed nutrition of a particular part are liable to be modified by the structure of the surrounding natural tissues;—the regular production of mucus on the surface of the digestive tube is thus supposed to influence the character of the contained matter of the cancer. M. Cruveilhier, on the other hand, ascribes the comparative frequency of this form of affection in the stomach to the great tendency of that organ to carcinomatous disease in general. This is a less hypothetical mode of accounting for the fact, and evidently better reconcileable with the occurrence of colloid in parts unconnected with the mucous secretions. There is an excellent specimen of the disease in the mamma, referred to by Müller, in the collection at St. Thomas's Hospital. Professors Bérard, Velpeau, and others, have observed it in the extremities; and it appears to occur with tolerable frequency in the shoulder and upper part of the arm. The museum at Guy's contains a preparation of the disease in the testicle.

In describing a specimen of reticular carcinoma (scirrhus), Müller states that he found in its substance a mass of alveolar colloid as large as a hazel-nut; and adds, that he has more frequently seen this form complicated with simple scirrhus. Such association of these two species of cancer is nevertheless, we apprehend, rare; no example of it occurs in the museums of the metropolis. It is important that the homogeneous jellylike pulp frequently seen in the interior of scirrhus, and which is nothing but its own substance softened, should not be confounded with true alveolar colloid; the latter not unfrequently exists in the same tumour with encephaloid.

In the description of scirrhus, the comparative rarity of the co-existence of several tumours in the same subject has been noted; this is still more marked in the case of colloid. M. Cruveilhier states that it is rare to observe its successive or simultaneous development in a number of organs or parts. Dr. Hodgkin expresses himself nearly in the same tone, but adds, that it does at times invade different localities in the same subject. It may coexist with the two other species of carcinoma in distant organs. In the case of the disease in the stomach already adverted to, the left ovary presented a solanoid mass, and the cervix uteri was infiltrated with scirrhus.

Varieties.—One of the distinguishing attributes of this species of cancer is its apparent insusceptibility of assuming such variation of internal arrangement, as to call, in this point of view, for the establishment of varieties: but the properties of the contained matter are not always the same; instead of being simply jellylike, it may be perfectly transparent and almost white, constituting the alveolar cancer *à matière perlée* of M. Cruveilhier. This substance is represented to be tenacious, yet without adhesion to the containing cells and easily enucleated; the contents of each cell resembling "a small pearl of the finest water." Or the contained material may be opaque, of yellowish hue and tallow-like aspect, with granular fracture and feel, and the chemical constitution of caseum. Under these conditions it has been met with in the bones, uterus, vagina, and walls of the urethra, and constitutes the *areolar pultaceous cancer* of the same pathologist. These modifications are comparatively unimportant, while the fundamental alveolar character is preserved.

§ 2.—*Physiology.*

We propose examining under this head some of the phenomena influencing and attending the evolution of carcinoma,—the circumstances of its origin, growth, and decay. We shall consider the different species together, in order to avoid the repetitions which, on account of the similarity of their physiological processes, a separate examination of each would unavoidably entail.

(*a.*) Origin.—It is unnecessary to review all the hypotheses brought forward at different times respecting the seat and origin of cancerous matter; the majority of these are either so *primâ facie* absurd, or so repugnant to the results of sound observation, that they are only fitted to figure among the curiosities of medical literature. The reader may well be spared an inquiry into speculations ascribing cancer to the atrabilis or a melancholic humour —to lymph converted into an acrid and destructive fluid — to the presence of a gas possessing properties analogous to those of hydrosulphuric acid—to fluids spontaneously effused and rendered corrosive by putrefaction—to a depravation of the nervous fluid—to "insects or the germina of these taken up from the air by the lymphatic vessels[1]"—or to a virus composed of an ammoniacal fluid containing oxide of nitrogen in excess. Nor is it adviseable in a work of this kind to do more than mention the theories of Dr. Adams, who supposes carcinoma to be the result of the generation, growth, and multiplication of a particular entozoon (the "hydatis carcinomatosa"); of Dr. Baron, who likewise attributes the diseased formation to hydatids, but denies its "animalcular existence;" or of Mr. Carmichael, by whom cancer is regarded as "an animal fungus possessed of independant vitality." Such doctrines only shall be particularly noticed as are remarkable for their influence on general opinion or their speciousness.

Pouteau professed that the disease is primarily induced by a mechanical lesion of the affected parts. He conceived that this injury, a blow for example, necessarily leads to the extravasation of blood and other vascular fluids; that the effused blood liquefies, acquires acrid properties, irritates the circumjacent nervous filaments, and thus originates a growth which in process of time becomes dense and voluminous.

Hardly differing from this fundamentally is the notion taught by Abernethy, that deposition of the coagulable part of the blood is the first step in the formation of all adventitious structures. This extravasation might, he conceives, be the effect of an accident, or of a common inflammatory process, or of diseased action of the surrounding vessels, and take place either in the cellular tissue, in the parenchyma, or on the surface of organs. The subsequent development and increase of this matter, when once organized, he believed to depend on its own inherent powers and upon actions maintained in itself. It is now understood that effusion of blood does not necessarily precede the formation of tumours, and hence that Abernethy's theory is untenable.

In 1815 C. Wenzel undertook to prove that scirrhus and induration were one and the same thing, and carcinoma nothing more than inflammation of indurated parts. If Broussais be believed, cancer is a result of acute or subacute inflammation, and the progress of the former is always in the ratio of the intensity of the latter; external cancer is the product of an irritative degeneration of the tissues in which fat and albumen abound. Similar notions were entertained by Breschet and Ferrus: these writers maintain that cancer invariably succeeds irritation or inflammation, and is incapable of being developed, unless in situations where either of those states has pre-existed. Inflammation, they allege, leads to the effusion of coagulable lymph (fibrine), or of a strongly concrescible albuminous liquid into the cellular element of the tissues; the effused matter is, according to circumstances, either absorbed or remains as an indurated mass tending to disorganization. Scirrhus they, like Wenzel, consider identical in nature with the indurations or callosities, which occasionally form on the confines of wounds and fistulæ. The sophistry of the system of argument by which the doctrine of irritation is upheld is notorious; but the facts, that simple induration is a state distinguished by its inactivity, while scirrhus possesses in itself an active principle of increase and growth; that carcinoma assimilates to its own nature the tissues it attacks, while inflammatory induration is modified by the particular structure affected; furnish a better refutation of it than any critical exposure of its fallacies. The former important result of clinical observation is confirmed, while it is explained, by microscopical investigation: the materials exuded in simple induration never contain any cell-globules provided with germs of young cells; in carcinoma, on the contrary, an inherent power of growth is produced and maintained by the formation of globules containing in themselves the embryos of a secondary crop of similar bodies. (Müller.)

From this error the disciples of the eclectic school easily steered clear. M. Andral, reflecting on the impossibility of producing any form of carcinoma by exciting even the most intense degrees of inflammation in the tissues of animals, on the frequent formation of that substance, where no local or general symptom of irritation has preceded its appearance, and on the far from uncommon presence of cancerous masses in the midst of tissues possessing every characteristic of the most perfect health (*e. g.* in the lung and liver), had no hesitation in rejecting the doctrine of Broussais. He admits, as all will do who have had opportunities of satisfactorily ascertaining the early condition of the diseased part, either by direct observation or through the testimony of intelligent patients, that irritation sometimes precedes and appears to act as the local exciting cause of the growth of the morbid structure ; but to this occasional influence he limits its power. M. Andral believes that every agency, which modifies the processes of nutrition and secretion, tends to give rise to the formation of adventitious matter in the cellular structure of organs.

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[1] Justamond (p. 65) quotes a thesis by Martin Schumacher and the work of Quadrio to show that he was far from singular in entertaining this opinion: the latter had seen the insect, and describes its length, breadth, and colour.

Some years since our distinguished countryman Dr. Hodgkin endeavoured to show, by a train of very ingenious and plausible reasoning, that the production of cancerous growths depends on the presence of simple or multiple cysts. "If," says this anatomo-pathologist, "we carefully dissect down to the surface . . . of a tumour, in which the progress of decay has either not commenced or has made very little progress, we shall find that the surface, which is next to the mass of the tumour, is more or less smooth and even ; and on raising *it*, we find that it is reflected over one or more somewhat pyriform bodies, attached by a base, which is generally narrow and peduncular, to some part of the circumference of the enclosing capsule. . . . . . . It must be sufficiently obvious, that the appearance presented by the section of a tumour such as I have just described must be very materially affected by the direction in which the section is made. If it pass through or near to the point at which the pyriform bodies are attached to the enclosing cyst, it must more or less nearly correspond with the direction which some of these bodies take towards the circumference ; and their edges will consequently be seen in the form of radiating lines. On the other hand, if the section be made more or less nearly transverse to the axes of these bodies, their sections will convey the idea of cells of various shapes. If, continuing the dissection, we raise the outer cyst, or the membrance reflected from that which covers the radiating pedunculated bodies, we shall *generally* find, that on one or more sides it dips down deeply into the mass of the tumour. It thus forms part of a septum, which separates one packet of pedunculated bodies from the others, which usually concur to form the mass of the tumour ; for it, comparatively, rarely happens that the tumour is composed of a single cyst filled with pedunculated bodies[1]."

Thus, according to this investigator, the existence of carcinomatous matter involves that of a cyst ; the former cannot be developed unless in the latter, which is therefore at once its seat and source. Now although this theory leaves the causation of cancer as much unexplained as ever (for the development of the cyst itself remains to be accounted for), it is, if well founded, a very important contribution to the anatomy of these diseased structures, and therefore deserves to be carefully examined. Serous cysts are undoubtedly often associated with carcinomatous growths. In the first place, as we have already intimated, a lamina of serous aspect forms, in rare cases, the internal layer of the capsule of encephaloid tumours, in the manner described by Dr. Hodgkin. But we are not acquainted with any facts proving that this lamina precedes the cancerous substance in order of development; the contrary is indeed more likely to be the truth for the following reasons: the lamina in question appears to be simply a modification of the inner surface of an ordinary capsule of condensed cellular membrane, which is confessedly, when it exists, formed subsequently to the cancerous mass ; the connexion between the cyst and its contents is not necessarily either close or universal, nor, according to the experience of numerous observers, are the cellular septa of the tumour distinctly productions from it. Secondly, though serous cysts with contents of different kinds are frequently seen in the interior of cancerous growths, we have never yet observed a particle of encephaloid, scirrhus, or colloid actually within the cavity of such contained cysts; though it is far from uncommon to discover a protrusion inwards or partial collapse of some portion of their walls, probably from local activity of growth of the cancerous tumour. The origin of these internal cysts we shall hereafter endeavour to explain. Thirdly, in connexion with simple or multilocular cysts of the ovary and mamma, encephaloid vegetations of various sizes and shapes are occasionally found protruding into the cavity of those cysts ; but we have not been able to ascertain that such vegetations are surrounded by a serous sac developed within the original one. It is, we think, evident that the carcinomatous matter originates in these cases between the external surface of the pre-existing serous membrane and the adjoining stratum of cellular or fibrous tissue, and hence that the extent of surface of the cancerous growth covered with a reflection of the former is always in the inverse ratio of the breadth of base of that product. Laennec had noticed this partial cystic investiture under other circumstances, and attempted to explain it by supposing the cyst in course of formation ; but this hypothesis is untenable : the peculiarity seems to be caused from cancerous matter, produced outside a pre-existing cyst, carrying inwards the adjoining portion of the serous lamina and eventually bringing it into contact with the opposite circumference. In this case the relation of the cancerous structure to the cyst is that of the testicle to the tunica vaginalis ; the former is partially invested by the latter, but is without its proper cavity : and, in truth, according to Dr. Hodgkin himself, this is the mode of connexion of the morbid matter and cyst, for it is clearly impossible that the superadded growth should at once be within the cavity of the serous sac and invested by a reflection of it. So long then as the connexion of cysts with cancer is traceable, their independence as cause and effect seems apparent. Besides this, it has been alleged by Dr. Carswell, who has used very much the same line of argument as the above, in refutation of the cystic theory, that carcinomatous structure, when connected with a cyst, is supplied with blood by vessels not belonging to that membrane. This pathologist admits that cancerous matter may be thrown out on the internal surface of accidental cysts developed in subjects of a cancerous diathesis: he does not, however, state that he has actually seen carcinoma so situated.

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[1] Morbid Anatomy of the Serous and Mucous Membrane, p. 251.

The theory just examined makes the existence of a cyst of primary importance in the formation of cancerous matter; but Dr. Hodgkin modifies, in another part of his volume, its obvious bearing in this respect. He there "takes views of the commencement of the adventitious structure, which exclude the question as to the priority of the cyst or its contents, as the formation of both is almost simultaneous, and proceeds *pari passu*" (p. 281). All claim to formative function on the part of the cysts is here relinquished.

M. Cruveilhier, whose laborious attention to pathological anatomy for a number of years entitles his inferences to most attentive consideration, professes opinions on the subject of the seat and origin of cancer materially different from those held by his contemporaries. M. Cruveilhier's doctrine embraces two essentially distinct propositions. First, he regards all heterologous formations "as the exclusive result of a successive deposition of morbid products in the cellular element of organs;" he believes that "this cellular element is alone affected; that the proper tissue of organs is in itself incapable of undergoing any organic lesion, except hypertrophy and atrophy; that at first rendered hypertrophous by the state of irritation existing in the neighbouring cellular membrane, these proper tissues subsequently become atrophous and finally disappear in consequence of the pressure they undergo from the diseased formation." But this unalterableness of composition of the organic tissues is the least important part of the doctrine; for, secondly, "it results from his researches that the formation of cancer, like all nutritive phenomena, physiological and morbid, takes place in the venous capillary system; that from it the morbid products are poured into the cellular membrane, either by exhalation or through lacerated openings[1]." This latter proposition, as it affects cancer, is evidently only a part of his more general theory, according to which the various phenomena of nutrition, secretion, and inflammation, are accomplished, not as has heretofore been believed in the arterial, but in the venous capillaries. It would be foreign to our present purpose to inquire into the validity of the arguments on which the learned Professor rests his general doctrine; we have at present only to do with the particular evidence adduced by him to prove that carcinoma occurs primitively and invariably in the seat he has assigned. Now in the numerous passages of his great work in which this theory is emphatically dwelt on, and pronounced to be a demonstrated truth, we find no single fact but the occurrence of carcinomatous matter in the veins advanced in its support. We shall by and by inquire whether the inference from the fact is perfectly warranted.

Dr. Carswell has investigated the delicate points under consideration on the correct principle that, in order to obtain satisfactory results thereon, the morbid matter must be observed as soon as possible after deposition, and its development thus traced, as it were, *ab ovo*. Examining the question in this way, he conceives he has ascertained that carcinoma originates in three positions—in the molecular structure of organs as a product of nutrition; on free serous surfaces, as a result of secretion; and in the blood.

Deposition in the molecular structure of organs is exemplified by the mode of formation observable in the liver. If a liver studded with carcinomatous growths be closely examined, certain minute spots may be detected, in which a slight change of colour indicates the commencement of the process of morbid formation. This alteration of colour may be limited to a single "acinus," or occur in several of these bodies either successively or simultaneously. Their natural colour is succeeded by a pale milk-white, or straw tint, the alteration being attended with an increase of consistence; but at the same time, and this is represented to be the most important circumstance attending the diseased process, the form and bulk of the "acini" remain unaltered. Hence it is inferred that the foreign substance must be introduced in the same order as the normal element of nutrition; otherwise a change of bulk would coadvance with that of colour and consistence. M. Cruveilhier also observes, that cancerous growths of the liver in the nascent state accurately represent in point of form the hepatic granulations, and that the disease originates in the granulations themselves, and not in the cellular membrane connecting them[1]. Admitted by observers whose theoretical notions are very widely opposed, there can be little doubt of the reality of the alleged fact; their explanation differs however: that of Dr. Carswell we have just seen: according to the French pathologist the venous capillaries are in the hepatic granules, as elsewhere, the anatomical element primarily affected. Dr. Hodgkin on the other hand believes that the cellular membrane accompanying the vessels and ducts is the texture in which the diseased formation commences. The judicious use of the microscope is absolutely required to enable us to decide with which of these opinions truth lies.

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[1] The escape of the cancerous matter from the capillary vessels is a point of inferior importance, and apparently rather accidental than otherwise, according to M. C.'s notions. In speaking of cases in which the uterus looks healthy, though it affords cancerous matter on expression, he states that the veins are its containing element, but that as they retain their normal dimensions, there is no atrophy of the proper tissue of the organ. Where there is formation of distinct tumour, the coats of those vessels become enormously distended by the morbid matter, and excessively fragile. Livrais. xxvii.

[1] Livrais. xii. Foie, p. 5.

The alleged fact that carcinoma is thrown out on the free surface of serous membranes, is adduced by Dr. Carswell as strongly corroborative of the views just stated respecting the nutritive transformation of the tissue of organs, for the distinction between the processes of nutrition and secretion is merely nominal. The analogy is, no doubt, strong; but the production of cancerous matter on free serous surfaces—we have ourselves never seen a specimen in which the morbid formation distinctly occupied this situation—is, to say the least, an extremely rare phenomenon. Indubitably, the vast majority of growths connected with serous tissues are developed in the cellular membrane beneath them; this we have had frequent opportunities of ascertaining by careful dissection of incipient pleural and peritoneal patches; even the growths figured by Dr. Carswell, as illustrating his opinion, appear to be contained in a pouch of the distended serous membrane. Cancerous tumours of the meninges, when connected with the arachnoid, originate either in the cellular tissue between the internal surface of the dura mater and the parietal portion of the serous membrane, or under its cerebral lamina; their investment by the arachnoid is demonstrable by dissection. In such reports of cases of similar disease of the pericardium as we have met with, the morbid product is described to have been seated on the attached surface of the membrane[1]. But the question is, we admit, not one of frequency; if carcinoma has actually been *effused in a single instance* into a serous cavity, Dr. Carswell's thesis is defensible[2]. Persuaded of the fact, this eminent pathologist ascribes it to the "*separation*" of the morbid matter from the blood. This leads us at once to consider the state of that fluid.

As the subject of cancerous vitiation of the blood itself is an extremely important one, we shall lay before the reader, as concisely as possible, such facts as have been established respecting it, and the conclusions drawn from these by different pathologists. The earliest careful observations respecting the presence of cancerous matter in the vascular system appear to have been by M. Velpeau[1]. In 1824 this inquirer read an essay to the Academy of Medicine containing two cases related with much precision. In one of these an encephaloid mass appeared in the vena cava communicating with similar structure in the kidney; and an enormous coagulum extending from the iliac veins through the cava inferior to the right auricle, presented from place to place the characters of encephaloid matter of varying firmness. The coagula in the heart had apparently formed after death, yet in one of them, placed between the walls of the ventricle and the tricuspid valve, was contained "some substance of purulent *or* encephaloid aspect, like that contained in the kidney." In 1829 M. Andral announced his having discovered carcinomatous matter in the trunk and minute ramifications of the pulmonary artery; in other instances, in the branches of the vena porta, &c. In the same year M. Cruveilhier, in describing a case of cancer of the uterus and vagina, stated that on cutting the latter membrane slantingly, he ascertained, with the aid of a lens, that the venous areolæ of the vaginal mucous membrane were crammed with encephaloid easily expressible from their interior. M. Bérard's observations in the same direction have already been noticed.

These facts are all evidently referrible to the same category, and simply prove the presence of carcinoma in the interior of the venous system. But the inferences drawn from them are in each instance different. M. Velpeau concluded, from an examination of all the particulars of his cases, that the encephaloid matter in the midst of the venous coagula was not a production of the internal tunic of the vessels, (that tunic was healthy, and not closely connected with the adventitious product,) but actually formed in those coagula; and further that the germ of all such heterologous tissues exists primitively in the blood[2]. M. Andral partly coincides in this opinion, maintaining that the presence of the abnormal substance in the blood depends upon transformation of the fibrine of the latter into the former. M. Cruveilhier discovers in the same fact, as we have already intimated, a proof that cancer is a product of secretion by the coats of the capillary veins. M. Bérard entertains no doubt that in the cases observed by him the presence of the foreign formation in the veins resulted from partial destruction of their coats (as long since described by Sir C. Bell[1]); but he admits that the fact of free encephaloid masses being found in the interior of vessels with sound parietes is not thus explicable.

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[1] A case related by Dr. Bright (Med. Chir. Trans. vol. xxii. p. 17.) appears to furnish an exception to this statement.

[2] Vessels have recently been spoken of as "shooting into the serous cavities, as it were into space;" and, we believe, such vessels are said to contain cancerous matter occasionally. But even if these propositions shall have been proved, they will lend no support to Dr. Carswell's notion; there is no analogy between such mode of production of cancer and its effusion or exhibition from the serous substance.

[1] Mr. Langstaff (Med Chir. Trans. vol. viii. p. 286, 1817,) had already noticed the fact of such presence; in a case of encephaloid disease dissected by him, "some of the veins were filled with matter of the same consistence without its having formed any adhesion with their coats;" but he does not appear to have attached any importance to the discovery.

[2] Rev. Médicale, 1825, vol. i. p. 357.

Now these pathologists have not endeavoured to prove what is absolutely necessary for the establishment of the doctrine of the production of encephaloid matter in the blood itself or by the coats of the capillary veins: they have not shown that such matter is ever detected in the venous system in cases where no such morbid deposit has pre-existed in the cellular structure of the solids. Hence they have furnished no evidence contradictory of the much easier and more natural explanation that the diseased masses in the venous coagula had found their way into the veins by absorption. It seems highly probable, too, from recent microscopical researches, that in some of the instances referred to, the substance presumed to be encephaloid was not really of that description.

Such was the state of knowledge on the subject when Dr. Carswell announced himself an advocate of the origin of carcinoma in the blood. This pathologist does not found his conviction on the mere existence of cancerous matter in the veins; he affirms not only that the morbid production may be discovered in vessels having no direct communication with an organ affected with the same disease (as when confined to a small extent of the vena porta), but that there are cases in which the venous blood alone is found to be the seat of the morbid accumulation. Of the first of these observations we readily admit the accuracy, but it by no means disproves the fact of venous absorption. There does not seem to be any direct communication between the parenchyma of the lungs and the bones of the extremities; yet the celebrated experiments of M. Cruveilhier show that a single globule of mercury introduced into the medullary cavity of the femur may be detected weeks after in the pulmonary tissue. Nay more, they have proved that mercury, introduced into any part either of the general or portal venous systems, may reach in the first instance the capillaries of the liver, in the second those of the lung. With respect to the second observation, we can only say, that among a vast number of post-mortem examinations, conducted by men familiarized with such researches, we have never seen a case of the description referred to, we have never heard of one, and we have in vain searched periodical works for details demonstrating the reality of its occurrence. Were the fact substantiated it would furnish strong evidence of a *primary* cancerous alteration of the blood, provided the adjoining venous structure were shown to be wholly unimplicated; but while unsupported by a full narrative of the cases from which it professes to derive, the doctrine of such alteration, no matter how eminent the individual by whom it is adopted, can only, we apprehend, be regarded in the light of an hypothesis[1]. The fact that the heterologous substance is not discovered in the arterial system (Cruveilhier's statement [p. 594] requires substantiation) is accounted for by Dr. Carswell by supposing that the contractile power of the arteries prevents stagnation of their contents; how far this may be considered an answer to an obvious argument against his theory, we are unprepared to say; it is certain that it is far from convincing.

Further, as Dr. Carswell regards the deposition of carcinoma, through the processes of nutrition and secretion, as the result of its *separation* from the blood, cancerous vitiation of that fluid, preceding the origin and coexisting with the growth of the local malady, is a *sine quâ non* of the development of the latter: according to him the blood is, in a word, the sole primary seat of the disease. Hence the material element of the affection is in circulation in cases, for instance, of scirrhus of the mamma, which remains almost stationary for years, is unattended with secondary formations in other parts of the frame, and gives rise to no marked constitutional disturbance. Now this idea is by others rejected as inadmissible; can we readily comprehend, they allege, how blood holding cancer in suspension can furnish the materials of normal secretions and perform its functions in such manner as to cause no perceptible deviation from the standard of health? How comes it again, it is urged, if this doctrine be well founded, that after the removal of a cancerous tumour the process of cicatrization frequently goes through its stages with regularity, though when the patient dies, one or more viscera are found affected with the disease in such manner as to leave little doubt, in some cases none, that the morbid growths discovered in them were in existence before the performance of the operation. If these facts are reconcileable with the theory espoused by Dr. Carswell, he has at least failed to make manifest their compatibility therewith. For our own part, while we distinctly avow that the difficulty of explaining the apparent contradictions involved in this doctrine furnishes no *proof* of its unsoundness, we reject it as unestablished by experience.

Again, though we look upon it as almost demonstrated that cancerous matter found in the veins has in the majority of cases come there by absorption (see the section on Pathology), yet we are by no means desirous of upholding an exclusive opinion on the matter. Facts well observed prove, in the first place, that growths external to those vessels, in some instances perforate their coats, protrude into, and extend laterally in, their interior. Nor do we deny the possible conversion of coagulated blood into encephaloid ; we simply alledge that such transformation is as yet unproved. Thirdly, published cases tend to prove the occasional production of carcinoma by the coats of the veins ; circumscribed tumours are sometimes found attached to the walls of these vessels by a simple or multiple pedicle (not unfrequently dilating the vein, as M. Cruveilhier observes, into an ovoid ampulla simulating a cyst). These tumours are evidently in organized connexion with the vascular tunics—a fact arguing in its favour, though it by no means demonstrates their production thereby[1].

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[1] Surg. Obs. vol. ii. p. 405, 1818.

[1] Granting that cancerous matter be discovered in the interior of the blood-vessels, it would be necessary to prove its absence not only from the cellular structure of the trunk and extremities and various viscera, but from the substance of the bones, before we become entitled to affirm that it is exclusively contained in those tubes.

It may, we think, be fairly inferred from facts hitherto ascertained, that the primary seat of carcinoma is the intervascular interstices of all the organized tissues and parenchymata, in rare instances possibly free serous surfaces and the interior of the veins. Wherever there are capillary vessels composing a nutritive or secretive apparatus, cancerous matter may be produced ; that it may be sometimes retained in these may reasonably be supposed, but there is at present no proof of the fact. Secondly, the proximate cause of the formation consists in a perversion of the acts of nutrition or secretion. But though we believe it unnecessary for the comprehension of cancerous development to admit that the material element of the disease circulates with the blood previously to its local manifestation—that a *cancerous vitiation* of that fluid is the first step in the train of morbid changes—we do not mean to affirm that the blood possesses its normal constitution even at that period ; and further we are persuaded that when *secondary* cancerous impregnation occurs, it must exercise a material influence on the activity and increase of local growths. Both these questions, which refer to the doctrines of diathesis and secondary formation, will be attended to elsewhere.

If doubt and uncertainty still hang over the points just considered, pathologists are yet more ignorant respecting the nature, and indeed the existence or non-existence, of a local structural change in the elementary constituents of the tissues preceding the deposition of cancerous matter. The German inquirers have not applied the microscope to this fundamental part of the subject ; and no authorized statements have yet appeared from the observer in this country, who has long been employed in its investigation.

(*b.*) Growth.—Like all bodies possessed of the power of adding to their own development, carcinomatous tumours grow by intussusception ; they abstract from the blood materials for conversion into their proper substance, and are the seat of circulation, absorption, and nutrition. We have already referred to the vessels of these growths, to the difficulty of detecting them in scirrhus and their abundance in encephaloid. Some of these vessels are manifestly in communication with those of the surrounding tissues ; while the relation of others in this respect is yet matter of uncertainty. The mode of formation of the latter appears traceable with the naked eye as follows. In one point of a tumour may be seen some minute unconnected points of blood ; at another a number of such points united in linear juxtaposition, so as to form a streak of blood uninclosed in any distinct vessel ; elsewhere a vascular investment is found for a similar streak ; further on, a similar piece of delicate tube divides at each extremity into a number of tapering ramifications, assuming a stellate arrangement. So far as these facts go, they argue in favour of the opinion of Cruveilhier, Carswell, and others who regard the vessels in question as " perfectly independent of the general circulation," and formed *de novo* in the morbid matter, in the same manner as the vascular tissue of the ovum. But as this opinion is one which clashes with received physiological notions, and as the appearances referred to are of gross character, while the earliest phenomena of formation require the application of the microscope, it cannot be embraced without hesitation. Dr. Hodgkin and others regard the notion of new-formed vessels as totally inadmissible. See Pseudo-Membrane. Be this as it may, the tubes in question (in which Lobstein affirms that he saw the circulation going forward with the help of a common lens) constitute what Dr. Carswell terms the *proper* circulating system of encephaloid in contradistinction to the manifest offsets from the surrounding arteries, which form the *collateral* supply. The predominance of either of these systems appears to vary with the consistence of the growth ; the collateral is most abundant while the tissue is firm and resisting, the proper under the contrary circumstances.

Different opinions are professed respecting the origin of the containing element or septa of carcinoma. While some maintain that it is formed of the natural cellular tissue of the part in a state of hypertrophy and induration, the majority of writers consider it a new formation, as proper to carcinoma as the contained matter. Dr. Carswell remarks in confutation of the former opinion, that cellular membrane in a state of acknowledged hypertrophy, such as is met with in elephantiasis Arabum, has no tendency to terminate in cancer, nor does hypertrophy of the heart from disease, or of the muscles from frequent exercise, ever present any other change (except slight increase of consistence) than that implied by this term; besides carcinoma appears in situations where the cellular tissue is either very scanty or does not at all exist. According to Dr. Hodgkin the septa are "neither the dilated terminations of the extreme branches of any of the three vascular systems, nor modifications of the cells of the cellular membrane," but the walls of newly-formed cysts, as already explained. The microscopical descriptions of Müller argue for their new formation. On the other hand Cruveilhier believes them composed of the parietes of distended veins; an obvious difficulty attending this notion being got over by the hypothesis "that the existence of a natural venous plexus, wherever a normal secretion is accomplished, and of an adventitious venous plexus wherever an accidental morbid secretion or process is in activity, is a *law* of the economy."

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[1] In M. Cruveilhier's twenty-ninth Fasciculus is the engraving of a large lobulated polypiform encephaloid mass found attached to the wall of the right auricle, almost completely filling that cavity and extending into the right ventricle and both venæ cavæ. The continuance of life under such circumstances is only explicable by supposing the growth of the tumour to have been extremely slow. No suspicion arose during life of an affection of the circulating organs being in existence. The patient died suddenly after a hearty meal, in all probability from some derangement of the relative position of the diseased mass, the valves and orifices of the organ. The parotid glands were the only other organs affected with the disease.

The opinion of Cruveilhier is purely hypothetical; neither of the others is exclusively correct. That the septa of one variety of mammary scirrhus are formed of the laminar intersections of the gland does not admit of a doubt; but they are these laminæ not merely thickened and indurated, but also infiltrated with cancerous matter: in another variety the lactiferous ducts manifestly form the radiating septa of the growth. On the other hand the argument of Dr. Carswell respecting the absence of cellular membrane proves conclusively, that in some situations the septa are of new growth. Besides, as has been remarked by Bérard, if the new portion of carcinoma were limited to the contained matter, this morbid structure would hardly present the uniformity of aspect and properties which, with unimportant exceptions, it is observed to possess in every organ and tissue of the economy. The exclusiveness of authors' opinions appears to have originated in their referring solely either to infiltrated or tuberiform cancer.

The application of the microscope has within the last few years given a new character to our knowledge respecting the growth and increase of carcinoma. Before stating the theory to which Müller has been thus led, we shall briefly describe the doctrine professed by Schwann on the development of the normal embryonic tissues[1]; the former is little more than a novel application of the latter. According to Schwann the primitive or embryonic structure of almost all animal tissues is demonstrably cellular; the component cells are, further, identical in point of structure with those of plants, and originate and are developed in pursuance of the same laws as those discovered by Schleiden to regulate the cells of plants. The young cells always contain a nucleus in their walls, from which they originally sprang; and they grow either within pre-existing cells (and consequently from nuclei formed in the cavity of those cells, and without connexion with their walls) or outside those pre-existing cells. Now the former mode of formation occurs according to Schwann in cartilage and in the chorda dorsalis[1]; the latter appears to prevail in many other parts, inasmuch as all the tissues of the embryo, according to the same physiologist, consist of cells with a parietal nucleus, and the origin of new cells in the interior of the old ones cannot be demonstrated in all of those tissues. In the adult, too, we have an example of the production of cells with a parietal nucleus *outside* the old cells in the instance of the epithelium; no encasement (*einschachtelung*) of cells is perceptible here. (Henle.) The formation of new cells is best observable where it takes place in the interior of old ones, that is where the nuclei apply themselves to new cells developed in the interior of the pre-existing ones. This development occurs in the following manner. Each nucleus produces a new cell, which protrudes from its surface like a watch-glass from a watch: with the progress of growth this new cell enlarges, and the nucleus remains permanently in its wall. When several young cells are thus produced in the interior of a mother-cell, they fill it completely when full-grown, and their walls become incorporated with those of the mother-cell. Fresh nuclei form in the interior of these young cells, producing in their turn a third generation and so on. The walls of the new cells are perfectly transparent; those of the old thicken, and in many cases become the seat of fibrous formation. Thus are produced and grow the cells of cartilage and of the chorda dorsalis, and probably of the decidua likewise. It follows further from these observations on the tissues of the embryo, that caudate corpuscula are a metamorphosis of primitive cells. The external membrane of the ovum, among other parts, regularly contains such bodies, which run into long filaments, and thus form the fibres of that tunic.

Now that the development of carcinoma proceeds on similar principles is according to Müller, from whom we have chiefly borrowed the above account, most satisfactorily traceable in colloid. (Pl. II. Figs. 6, 7.) The cells of this formation contain whole generations of more recent cells within them, which, as in the chorda dorsalis and in cartilage, originate from cytoblasts; the latter are, on account of their large size, yellow colour, and opacity, easily discernible in the cells of this species of cancer. When the fibrous formation, already referred to in the description of colloid, is developed on the largest cells, the fibres form the bed or stroma for the deposition of cells of younger growth.

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[1] See Froriep's Notizen, Nos. 91, 103, 112. January, &c. 1838. Schwann's observations were originally made on the embryos of the lower animals, some of them mammiferous: but that the mode of growth described by him prevails at least in the cartilaginous tissues of all animals, is spoken of by Müller as matter of certainty.

[1] This body must not be confounded with the spinal chord. The *chorda dorsalis*, which is developed along with the laminæ dorsales from the primitive streak of the embryo, and consists at first simply of a row of dark globules, more closely aggregated towards the anterior extremity than elsewhere, runs exactly in the axis of the future spinal column—the bodies of the vertebræ in fact form around it. It appears to be analogous to the cartilaginous filament found persistent in the vertebral column of some cartilaginous fishes. (Vid. Burdach's Physiologie, bd. ii. s. 244, 1828.)

In carcinoma simplex (scirrhus) and reticulare there is often, but not constantly, found, in addition to the appearances described in the section on the anatomy of these growths, a species of cell containing one or two smaller transparent vesicles with a minute nucleus. Müller considers it natural that these vesicles should not be invariably met with, as their discovery depends upon the observer's examining them precisely at the period of their internal development. But he is far from believing that all the cell-globules of these varieties of carcinoma originate in this manner as germinal cells in the interior of others, and subsequently become free by the bursting or dissolution of the mother cells, as occurs in colloid. Their appearance is not, he conceives, sufficiently constant to warrant this view. On the other hand the fact that several minute corpuscules are usually all that is discovered in the cell globules, argues forcibly in favour of the idea that new sub-cells grow as easily and even more easily outside than inside the pre-existing cell-globules; since these sub-cells are there developed from granules in the same manner as in the interior of pre-existing cells. These granules may become free either through the collapse or dissolution of a larger cell, to which they are attached, and then be developed; but they may also originate independently of and outside other cells. Here then we have the counterpart of the second mode of normal formation—that exhibited in the growth of the epithelium cells.

The microscopical cell-globules of colloid and scirrhus are not, as might be supposed, primarily dissimilar; the difference in the aspect of the two growths essentially depends on the different modes of development of these cells. In colloid the mother-cells go on increasing in size, and attain two, three, or more French lines in diameter, the walls of the sub-cells coalesce, and when these fill the mother-cell, become incorporated with its parietes. In scirrhus on the contrary this enlargement and cohesion of the cells do not occur, they are easily separable from each other, and retain persistently their primary condition of microscopical formative globules. The old cells appear to crumble away.

In the tumours with caudate corpuscula, these bodies are clearly formed, according to Müller, from cells with nuclei; for he always observed isolated cells, filled more or less distinctly with granular matter, and often provided with a manifest nucleus, associated in the same tumour with them, and predominating in its non-fibrous parts. Moreover the round cells pass by imperceptible degrees into those with tails, while the latter are transformed into filaments, and form the commencement of a fibrous formation.

Briefly to recapitulate the results of Müller's inquiries—he has advanced that cytoblasts form cells; that new cells are generated, either inside or outside those of prior existence, from a nucleus or granule; that the cells are under certain circumstances converted by flattening and elongation of their extremities into caudate bodies, (Pl. I. Fig. 7.) and that these caudate corpuscules when placed in lateral and terminal juxtaposition (Pl. I. Fig. 4.) form fibres. Hence by the persistent generation of cells the bulk of each growth is sustained and increased. In one species of cancer (reticulare) the fibrous appearance is stated to be produced by inlaying of granular corpuscula, but we do not find the nature and mode of growth of these, and the conditions regulating their fascicular arrangement explained.

It will be observed that the origin of the cytoblasts is in this theory the unsolved problem; until this be decided, whatever light Müller's researches may have thrown on the mode of increase of these products, they have by no means cleared up the history of their origin. The only probable method of discovering the cause and mode of their primitive production—the physical change directly preceding it, namely a minute scrutiny of the state of the vessels leading to the molecular seat of the disease, has not been pursued by this observer. "There is nothing peculiar," he affirms, "in the condition of the capillary vessels of most tumours, with the exception of those formed of erectile tissue." He has even omitted the anatomical description of the larger vessels of cancerous growths, on the ground that they do not differ from those of healthy parts; he says, however, incidentally, that the vessels of scirrhus are sometimes dilated and their walls thickened. Had Müller applied the microscope to the investigation of growths in the earliest stage of development cognizable by that instrument, instead of merely analysing the elements of tumours—had he traced the process of formation *ab ovo*, he might possibly have made a nearer approach to clearing up the mystery of their production.

From these investigations, however, an important fact apparently derives: the microscopical elements of cancerous growths and their mode of propagation are identical with those not only of benignant tumours, but of the normal embryonic tissues. But we cannot agree with Müller in his inference, that this identity proves carcinoma not to be a heterologous formation. As it appears to us, such identity simply shows that the heterologous character, visible and palpable as it is, is produced not by the nature, but by the mode of combination and arrangement of the ultimate physical elements of the diseased growth. As well might it be contended that calomel and corrosive sublimate are not heterologous to each other, because they are both composed of atoms of chlorine and mercury.

It may be well to remark, that whatever apparent resemblance the doctrine of Müller bears to the cystic theory of Dr. Hodgkin, there is no real similarity between them. In the one case the phenomena are microscopical; in the other putatively traceable with the unassisted eye: Dr. Hodgkin's cysts form only the containing element of cancerous tissues and do not constitute their contained matter; Müller's formative nuclear cells enter into the composition of both, and especially of the latter: according to our countryman new cysts form from the walls of old ones, and such, too, is the fact in true cystic structures; the German observer has on the other hand, as we have seen, shown that the formative microscopic cells grow from nuclei which may themselves originate free in the interior of or outside the mother-cells.

The variable condition of some of the properties of carcinoma next demands attention. The causes of its variation in *consistence* may be first examined. Laennec, believing he had observed that, when first deposited, carcinomatous matter is invariably firm and hard, and that it subsequently becomes soft and diffluent, as a consequence of its further development, looked upon the degree of consistence of the heterologous growth as a measure of its advancement towards perfect evolution. Hence originated his establishment of two stages of development—those of *crudeness* and of *softening*. But numerous pathologists, who have examined cancer since Laennec's time, have ascertained that its degree of consistence does not by any means furnish a correct estimate of the time elapsed since its formation, that the morbid matter may be extremely soft, nay, diffluent from the first moment it is perceptible by our senses, and hence that such state does not involve as a necessary condition a previous stage of induration. Nevertheless, thus much of Laennec's doctrine seems well founded,—that a tendency to decrease in density, no matter how soft they may have originally been, is an attribute of these products. His error lay in supposing that they must be primitively hard, and that their subsequent semi-liquefaction was a physiological result of development, instead of being, as it really is, a pathological process, the means whereby their inherent tendency to destruction is realised.

The chief circumstances affecting the physiological density of carcinoma are the nature of the deposit itself, and the peculiarities of the tissue or organ in which it is developed. If examined under favourable conditions for such investigation, that is when their proprieties cannot be materially or at all influenced by the nature of the part in which they are formed, manifest proof is obtained that the consistence of cancerous growths may depend on peculiarity of intimate composition. Subcutaneous tumours, for instance, belonging to the same species, exposed to the same extrinsic influences, discovered simultaneously and advancing in growth coevally, occasionally differ extremely in point of consistence; one may possess the firmness of a fibrous growth, another the pulpy softness of semi-putrid brain. Under these circumstances the difference depends on the relative proportions of the contained matter and containing cellular intersections. The consistence varies, too, according to the species of cancer. Again, the structure, density, situation and connexions of parts modify this property, as Dr. Carswell has pointed out. "The consistence of the new growth is influenced by its relative quantity to that of the tissues, in which it is contained [in other words, by the space free for its formation], or of a difference in the degree of resistance opposed by the latter to its accumulation or development. Thus it is more consistent in the liver than in the lungs or brain, in the skin than in the cellular tissue or a mucous membrane." But this doctrine is to be received with some restrictions; in the areolar structure of the bones as well as in their medullary cavity, cancerous growths are frequently of cerebriform consistence: scirrhus occurs in the brain; and encephaloid of the firmest character in the cellular tissue under the cerebral arachnoid. Besides, growths presenting the opposite extremes of density are often found in close contiguity in the same organ.

The *dimensions* of carcinomatous growths are influenced, and even more distinctly so, by precisely the same circumstances as its consistence. Thus, in respect of species, scirrhous formations, unless when of the infiltrated kind, reach a moderate size only, whilst encephaloid masses occasionally attain a vast bulk, and colloid productions observe a mean in this respect. Again, in dense parenchymata even encephaloid rarely exceeds an orange in size, in the lungs and testes it grows much larger, while in the subcutaneous cellular tissue it attains monstrous magnitude. The influence of pressure is here remarkable; while firmly bound down by fibrous resisting tissues, their development is obstructed, but when this obstacle is removed, the immediate result is a sudden increase of bulk. On this physiological fact has been founded one of the methods of treating carcinoma. In proportion to their perfection of vascularization is the facility with which they convert into their own substance the materials circulating within them, and hence too the volume they acquire.

The *rapidity of growth* of carcinoma is similarly affected by the same agencies. Encephaloid holds the first rank, colloid the second in point of rapid development. In respect of the influence of pressure, an encephaloid tumour, which may have taken months to acquire moderate dimensions, rapidly increases in size, when perforation of a compressing tissue opens a free passage for the expansion of the mass. An important illustration of this occurs in carcinoma of the meninges, the eye and orbit, &c. Further, idiosyncrasy probably influences the celerity of growth. As specimens of the quick progress occasionally observed, the reader may refer to some cases related by M. Andral[1]: in one of these, the most satisfactory in its details, an encephaloid growth of the greater omentum, rapidly extended from the great curvature of the stomach to the pubis, *daily* acquired an increase in size perceptible both by the eye and hand, and ultimately carried off the patient in less than five weeks from the appearance of the first symptoms. Dr. Carswell and Recamier narrate similar examples occurring in the lungs and uterus, and we have ourselves met with an instance of equally rapid growth in the extremities. On the other hand these growths sometimes scarcely exceed a walnut in size years after their first appearance: and the large tumour described by Gooch[2] had gradually increased in bulk during fifty years. Dr. Carswell observes that the more the varieties of carcinoma resemble the natural tissues of the body, the more abundantly they are supplied with cellular and fibrous membrane, the less rapid, *cæteris paribus*, is their development.

Effects on adjoining parts. — While the growth of carcinomatous tumours advances, the condition of the surrounding tissues may either remain unaltered, or, as is much more uniformly the case, undergo some one or more of a variety of changes.

In certain situations cancerous deposits may acquire considerable volume without apparently influencing the substance of the part in which they are formed. This is observed in the lung and in the encephalon, even when no cyst intervenes between the abnormal and natural tissues; hundreds of tumours are sometimes found in the liver, separated by perfectly normal structure. This is usually explained by supposing the adjacent structure to be driven aside, in proportion as the morbid matter is deposited; but if this were the case, indurated condensation would be produced; a stratum of tissue of variable thickness is probably removed by absorption.

The simplest effect produced on the circumjacent substance is its *condensation.* Of this we may again find an example in the pulmonary organs; subpleural encephaloid of such magnitude as nearly to fill one side of the chest and dislocate the heart, may not otherwise affect the lung than by compressing it into a small firm mass. This fact is more familiarly exemplified in the condensation of the adjoining cellular substance by subcutaneous tumours. Aided in some instances by slight hypertrophy of the cellular laminæ, a pseudo-cyst investing the morbid growth is thus developed. The formation of this natural barrier between the diseased and healthy tissues, more frequently observed in the case of encephaloid than of scirrhus, no doubt helps to defend the latter from infiltration with the morbid matter. The substance thus cut off, as it were, from surrounding parts, has less tendency to contract adhesions with them—a circumstance furnishing one of the diagnostic signs between the two species of cancer mentioned. Secondly, these tumours produce *mechanical effects* regulated by their size and position. Thus if developed around the vena porta, they interfere with the circulation in that vessel and induce ascites, &c.; if embracing or pressing on the aorta, they may cause partial or total obstruction of its cavity, as in cases related by Cruveilhier, Velpeau, and Lawrence[1]. When seated in the orbit, they cause gradual dislocation and extrusion of the eye, &c. Thirdly, *discoloration* of the neighbouring parts is sometimes effected in a manner as yet unexplained: thus the fat adjoining mammary carcinoma assumes a yellowish saffron tint. In advanced stages of cancer in the same organ, the integuments acquire a dingy green or olive hue, ascribable, as Dr. Hodgkin mentions, to changes in the venous blood. Various alterations of tint follow, too, from mere languor or obstruction in the tegumentary circulation. Fourthly, cancer, when so situated as to oppose the onward movement of the contents of hollow viscera, leads to *hypertrophy* of the muscular apparatus behind the obstruction. Thus in anal carcinoma the muscular tunic of the rectum undergoes thickening; when the disease is seated at the cardia, the œsophagus is similarly affected. The increased nutrition is however the mere result of the additional muscular power required to overcome the mechanical obstacle, and is not a specific effect of carcinoma. But a change of nutrition of another kind is sometimes observed in cancerous organs. In scirrhus of the mamma, as has been observed by Sir C. Bell, Scarpa, and others, the proper tissue of the gland occasionally suffers *atrophy;* in such manner that a breast in which an heterologous growth is encased hardly or not at all exceeds its healthy fellow in bulk. In other cases, on the contrary, the diseased organ undergoes general enlargement, or parts of it may be atrophous and others tumefied. The first of these cases is termed by Recamier *hypertrophous*, the second *atrophous engorgement:* the combination of the two states produces inequalities and bumps. Fifthly, carcinoma sometimes produces *absorption* of the part on which it presses. This is exemplified in the progress of meningeal cancerous growths which, after producing perforation of the cranium, sprout out through the opening: mediastinal carcinoma, also, not unfrequently leads to attenuation of the sternum, in the manner of aortic aneurisms. Sixthly, *serous infiltration* is frequently observed round subcutaneous and glandular tumours; and it is stated by Cruveilhier, that in cases of cancer of the cylindrical bones, the medulla is not unfrequently saturated with serosity. Seventhly, *inflammation* almost invariably occurs sooner or later in the tissues investing carcinoma: it is either eliminatory or not in its effects. Of the former kind we shall have occasion presently to speak: among the less familiarly observed examples of the latter may be cited gelatiniform softening sometimes produced in the cerebral tissue subjacent to meningeal cancer; peritonitis spreading from the seat of superficial carcinoma of the liver and giving rise to ascites; pleurisy occurring as a consequence of the extension of hepatic cancer to the diaphragm. Eighthly, *fibrous transformation* is sometimes observed. Cruveilhier has found the hepatic tissue between cancerous tumours converted into true fibrous substance, and relates a case of mammary carcinoma, in which the pectoralis muscle had undergone a similar change of structure. Ninthly, the extension of the disease to contiguous textures by *infiltration* occurs in the case of the three species, but not with the same frequency. Encephaloid has been by some considered more prone to push the adjacent parts aside, than to convert them into matter like itself: Abernethy considered this a fact of sufficiently constant occurrence and importance to warrant a complete separation of scirrhus and medullary sarcoma. But it is far from unusual for encephaloid of the cellular membrane of the limbs to spread to the adjoining tissues. Cerebriform growths originating under the peritoneum spread to the bones of the pelvis, and even of the thigh: this progressive destruction even of the hardest tissues was by Ruysch esteemed so important that he named the disease ossivorous tumour: we have ourselves observed cases, one in particular, in which the infiltration of the muscular, consequent on the pressure of a tumour in the cellular tissue, was so perfect that the former seemed formed of fasciculi of encephaloid fibres. Such facts are so common that it is needless to multiply illustration. Dr. Hodgkin goes so far as to affirm that encephaloid is more prone than scirrhus to affect the surrounding tissues by infiltration. In this extreme opinion he is, we think, unsupported by facts. Dr. Bright[1] coincides with this observer however, while Dr. Copland espouses the erroneous notion of Abernethy. The extension of scirrhus to contiguous textures is a very constant phenomenon; as it spreads, the scirrhous growth loses its circumscribed, rounded, moveable character. Perforation of the hollow viscera consequent on conversion of their walls into cancerous matter is an occurrence familiar to the clinical observer. Such destruction of the recto and vesico-vaginal septa forms one of the most deplorable epiphenomena of uterine cancer. Mr. Travers and Dr. Hodgkin suppose that the extension of the disease to neighbouring parts is preceded either by absolute inflammation in those parts or by a state of irritation almost amounting to this: no observed facts are adduced in confirmation of this opinion. The process of *adhesion* to surrounding tissues need not be separately described; it is effected by several of the changes just referred to, and will be further considered in describing the disease in particular organs.

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[1] Archives Générales, &c. t. ii. p. 209.

[2] Cases and Remarks; p. 165. 1758. The encephaloid nature of this growth cannot, however, be regarded as perfectly certain.

[1] Med. Chir. Trans. vol. viii. p. 13.

The albugineous tissues generally are remarkable for their power of resisting cancerous infiltration: a fact illustrated by the effect of fasciæ on these growths, by the progress of meningeal cancer and by the occasional coexistence of the disease on both sides of the sclerotica, itself remaining unaffected. The *arterial tissue* in connexion with carcinoma commonly remains unbroken for a length of time, while the investing textures undergo rapid destruction. But that the arteries are not always spared, appears from their occasionally giving way with dangerous facility, when ligatured in the immediate neighbourhood of cancerous formations. Fatal hæmorrhage sometimes results, as Bérard remarks, from extension of the disease to the chief artery of a limb, and hæmatemesis with a similar result has followed erosion of the splenic or coronary arteries in cancer of the stomach, &c. The adjoining arteries are sometimes dilated; Cruveilhier has seen nameless ramusculi, running to a mammary cancer, acquire the caliber of the radial. The *veins* in communication with these products undergo singular enlargement; but a similar effect is produced by other tumours. Numerous observers have ascertained that these vessels become morbidly friable, a fact particularly insisted on by Recamier. Of the presence of cancer in their interior, we have already spoken. The condition of the adjoining *nerves* varies. Their tissue may retain all its normal characteristics; it may be absorbed from pressure; become cancerous; or the nervous substance may alone be absorbed, while the neurilemma, thickened and indurated, assumes the characters of fibrous tissue. They have been more commonly observed to undergo encephaloid than scirrhous infiltration: Breschet has, however, found the areolæ of their tissue infiltrated with a liquiform matter resembling that of scirrhus. The *excretory ducts* of glands are sometimes stuffed with the morbid matter: the ureter has thus been found partially or wholly obstructed, and Müller has ascertained the same fact in respect of the galactophorous ducts. The condition of the *lymphatic system* will be examined elsewhere.

So far we have described the regular phenomena of development of carcinoma; but this tissue being, as the normal textures, the seat of nutrition, is like them susceptible of its disordered actions. The more important of these may be passed in review.

Partial or general *congestion* may be either, it is said, arterial or venous: in the former instance resulting from irritation, in the latter from obstruction to the venous circulation. The first consequence of this may be supposed to be a change in the colour of the diseased mass, if it be highly vascularized: in the one case a florid hue becomes manifest, in the other a purple, brown, or black tint.[1] But, chiefly owing to the delicacy of the vessels in the adventitious growth, the trifling support received from the substance in which they ramify and their imperfect communication with each other, extravasation of blood almost always follows. The *hæmorrhage* thus produced may, authors assure us, be so abundant as to cause a sudden and visible increase in the size of non-ulcerated tumours. Encephaloid, in which hæmorrhage of this kind has recently occurred, is found infiltrated with the effused fluid or broken down and mixed with grumous coagula: the appearances in the one case resembling those of the capillary apoplexy of Cruveilhier, in the other of ordinary cerebral apoplexy. Occasionally the mixture of encephaloid in small proportion with a preponderating quantity of blood produces a kind of pulpy detritus, excellently likened by Andral to the red grumous matter filling the loculi of certain softened spleens. The subsequent changes of the effused blood are strikingly similar to those observed in cerebral hæmorrhage. The liquid portion is gradually absorbed with the hæmatosine; the discoloured fibrine remains behind in a sort of cavity lined with a smooth and delicate membrane, while the circumjacent cancerous matter acquires a yellow tint: at a more advanced period the clot disappears, the lining of the cavity is more distinctly serous in character, its contents a serous or gelatinous matter. Such is, doubtless, the origin of the greater part of the cysts, of which we have already spoken, found in the interior of carcinoma. Wherever and under whatever circumstances blood is effused into the tissues, there is a tendency to the formation of a pseudo-membrane gradually assuming the serous character. See CEPHALHÆMATOMA, HÆMATOMA.

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[1] Guy's Hosp. Reports, vol. iii. p. 254.

Another and rarer mode of cerebral hæmorrhage, particularly described by Andral, in which the apoplectic cavity is traversed by filaments interlacing into a rete infiltrated with serosity, has also been noticed in encephaloid. Or, again, the coagulated fibrine forms a solid persistent mass, which, by undergoing various transformations, gives rise to the cartilaginiform, cretaceous, and ossiform particles, occasionally met with in these growths. When carcinoma of a gland is attacked with hæmorrhage, it is not unusual for some of the effused blood to escape outwards by the excretory ducts of the organ. *Extravasation of serum* may occur in encephaloid, and, according to Béclard, give that substance precisely the aspect of the brain, in a state of white softening. A variety of writers speak of *inflammation* of the proper substance of a cancerous tumour as an ordinary occurrence; but the allusions to the actual condition of the morbid matter, when thus affected, are vague and unsatisfactory. We are not aware how such process could be proved to have occurred, except by the discovery of pus in the morbid growth. Now that a fluid, possessing the gross physical characters of purulent matter, is occasionally so situated, is averred by numbers. Cruveilhier speaks frequently of the presence of pus in cancer as a point not admitting of doubt. But the ascertained outward similarity of liquified fibrine and pus seems to render it doubtful, (and at all events shows the importance of further demonstration) whether the common belief as to the frequent presence of the latter in these products is well founded. The testimony of Müller is, nevertheless, strong: he refers particularly to a specimen of reticular cancer, remarkable by its containing a number of cavities filled, some with caseous, others with puriform matter: the smallest of these purulent cavities (*eiterhöhle*) measured half a line in diameter, and were lined with a vascular membrane; but the microscopical and microchemical characters of the fluid do not seem to have been ascertained. In these observations we refer to pus formed in the cancerous matter itself: its production in any of the natural tissues accidentally imprisoned in a tumor, or its passage by imbibition from adjacent structure into the heterologous matter, are less debatable points.

Saline and colouring matters, as well as different adventitious formations, are found in some cancerous growths. The detection of microscopical crystals in encephaloid and colloid by Gluge and Müller has already been noticed.

Carcinoma occasionally presents a black tinge either from abundant punctuation, infiltration, or deposition in masses of *melanic matter*; and an attempt has been made by some authors, led by this accidental impregnation into a belief that melanosis constitutes a separate malignant formation, to class it as a species of cancer. With the holders of this notion we cannot, for the following reasons, agree: 1. Pure melanic pigment, no matter in what abundance it be accumulated, produces no other effects than those dependent on the mechanical obstruction caused by the mass it constitutes. 2. When melanotic tumours produce the local and general symptoms of cancerous growths, they are found to be composed either of encephaloid or scirrhus (more especially the former), impregnated with black matter. 3. Neither the local nor general symptoms of carcinoma are modified in cases in which melanic matter is found to pervade it. 4. Melanic matter is incapable of forming a tissue, being an unorganised fluid into which vessels have never been observed to penetrate. It has been remarked that when one cancerous growth is tinged with black matter, any others in the body are almost invariably found similarly discoloured: this fact, to which much importance has been attached, simply proves that there is a tendency in the system to the production of melanic matter. Again, Cruveilhier lays much stress on the circumstance that "melanic cancer" is rarely solitary: this is the necessary result of the fact, that black or bistre-coloured impregnation much more frequently complicates encephaloid than the other species of carcinoma. The French pathologist has not thought of proving, numerically, that such multiplicity of growth is less frequent when the encephaloid is of normal than of abnormal colour. See MELANOSIS.

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[1] Carswell.

A partial or general *yellowish tint* is sometimes produced in carcinoma, either, as in cases referred to by Laennec and Dr. Graves, by impregnation with the colouring matter of the bile; or, as is more usual, by the changes undergone by the diseased mass in the vicinity of effused blood, resembling those observed in subcutaneous ecchymosis and cerebral hæmorrhage. Dr. Hodgkin expresses his belief, that the yellow tint occurs in the oldest parts of these growths; a remark which we have not seen confirmed. But there is much justness in the observation, that encephaloid thus discoloured bears some resemblance to tuberculous matter; a similarity which has caused the former to be sometimes mistaken for the latter. In certain cases the origin of the yellow tinge is difficult to specify.

The partial conversion of cancer into *bony matter* is a phenomenon much spoken of by writers. Ossification, commencing with the central portion of scirrhous tumours and spreading thence to their periphery, is said to convert the whole mass of some scirrhi into bone. M. Trousseau states that he has frequently observed this mutation in bitches; and Dr. Hodgkin instances scirrhi of the uterus, as being especially prone, in the human subject, to such conversion. The septa, or enclosing pseudo-cyst of encephaloid are represented as occasionally undergoing osseous transformation, and M. Cruveilhier speaks of spheroidal ossiform concretions discovered in colloid of the muscular coat of the stomach. But we believe that, if we here exclude from consideration the bony lamellæ actually continuous with some part of the skeleton, and which form a marked characteristic of certain cancers connected with osseous structure, the phenomenon in question will be found to have been much more written of than observed. Dr. Hodgkin's opinion above stated is easily explained by the fact that he regards the well known "fibrous tumours" of the uterus as true scirrhus of that organ: and it is incorrect to term the matter developed in these cases bone, of which tissue it has not been proved to possess the structural or chemical character.[1] That cretaceous or calcareous matter is occasionally seen in carcinoma is nevertheless incontrovertible, and we have already alluded to its probable source. Dr. Hodgkin considers osseous formations comparatively more rare in encephaloid than in scirrhus, and attributes this to the greater vitality of the former; Breschet regards "conversion into bone or cartilage" as affording evidence of excessive activity of nutrition in the transformed part: no proof is adduced of either opinion.

Cartilaginiform substance has rarely been found in cancer. Rouzet reports a case from Lecomte[1], in which cartilaginous productions were found scattered through a scirrhus of the breast in the form of little round masses or acicular figures; but the true nature of these may be made a matter of doubt. Müller states that *fatty matter* is frequently seen in scirrhus, and that while the fat in true fatty tumours is contained in their formative globules, that occurring accidentally in carcinoma is free, and appears in the form of granules or crystalline particles.

Bayle describes a specimen of pulmonary encephaloid containing *tuberculous matter*, distinguishable from the cancerous texture by its yellow opaque appearance: there were tuberculous cavities in other parts of the affected lung. Admitting, however, that the substance presumed to be tuberculous was really of that nature, and not encephaloid accidentally discoloured (as was clearly the case in some of the instances referred to by M. Cruveilhier), it does not appear from the description whether the centre of the tumour was formed before or after the surrounding carcinoma. Andral speaks of tumours of the liver formed of a combination of encephaloid, scirrhus, and crude tubercle; Cruveilhier has figured a composite growth in connexion with the kidney, formed of a layer of encephaloid, investing a large mass of "tuberculous" matter; but such facts at the most only prove the occasional association of these morbid products.

It not unfrequently happens that a tumour possessing the characters of scirrhus in the main, discovers in some portion of its substance those of softened encephaloid. This circumstance has been adduced as proving that scirrhus may soften into encephaloid, and hence, as an unanswerable argument in favour of the identity of cancerous tissues, *ab origine*. But may it not depend on the development of encephaloid as a new product in the scirrhous mass? This is a mere hypothesis, it is true; but one more reconcileable with ascertained facts, than the notion that these structures are primitively identical. It surely will not be contended that an erectile tumour may soften into encephaloid, and that both are identical, yet the latter is frequently found in the former. Further, Müller has, as we have already stated, seen a mass of alveolar colloid in scirrhus, and has often observed colloid cancer contrariwise complicated with scirrhus. Is it reasonable to suppose that these two tissues are capable of hardening and softening into each other? In fact, the thing is impossible, for their elementary microscopical constitution and mode of growth are different.

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[1] Gluge has shown that the lamellar productions in the arteries, which are called ossifications, and which, in fact, possess more of the outward characters of bony tissue than most abnormal ossiform formations, are composed of microscopical saline crystals, united into a patch by albumen or fibrine. Between this elementary attempt at ossification and the new formation of true bone, as demonstrated by Mieschler, there are numerous gradations.—*Bull. de l'Acad. Roy. de Bruxelles, Avril*, 1838, p. 192.

[1] Journ. de Méd. t. 73, 1787.

The only example we have met with in periodical or other works of intimate association of cancerous structure and *hydatids*, is described by Wedemeyer. This observer discovered in the anterior lobe of one hemisphere of the brain, in a subject who had died with cerebral symptoms, a mass of scirrhous hardness and fibro-cartilaginous consistence "surrounded with a grey puriform semifluid matter containing some hydatid vesicles[1]." Unfortunately it does not appear whether this semifluid matter was softened cancer, or cerebral substance, gelatinized or infiltrated with pus.

(*c*.) Decay. Such are the more important phenomena occurring in these morbid growths, having no direct influence on their destruction and removal. But sooner or later their inherent tendency to destruction breaks into action and elimination commences. These processes are, in general terms, effected by the reduction of the tumour, partially or generally, into a pulpy matter, and the formation of an opening in the investing natural tissues. The mode in which this conversion into pulpy detritus is effected, is not, we apprehend, satisfactorily established; at least, no demonstration has been given of any of the theories adduced to explain it. Of Laennec's notion we have already disposed; Recamier, and a variety of writers, attribute the change to inflammation of the substance of the tumour—inflammation which is purely imaginatory; Lobstein to an "effort of nature to perfect the organization of the part,"—a fanciful hypothesis. Drs. Hodgkin and Carswell regard the change as the result of gangrene, itself produced in a variety of ways. In encephaloid, for example, extreme venous congestion sometimes ends in complete stagnation and local suspension of nutrition; if this state be persistent, mortification ensues. A similar result follows occasionally from the obliteration of a large venous trunk through pressure, and still more commonly from total obstruction of the veins with carcinoma. The cause of this venous stagnation may also be, according to these authors, very distinctly traced to the unequal growth of some of the minor tumours of which it is composed. The rapid enlargement of one of these interferes by lateral pressure with the circulation in another; an occurrence promoted by the pedunculated form. This form is again conducive to gangrene, where tumours, in the manner already referred to, pierce the cutaneous or aponeurotic structures; the edges of the unyielding tissue, which has undergone perforation, exercise forcible constriction on the pedicle of the tumour and interrupt its circulation[1]. But this theory involves some postulates not easily reconcileable with ascertained facts. Pulpy encephaloid is a dead-white or pink-coloured opaque matter of creamy consistence, without much viscosity, presenting no gangrenous odour, and never giving rise to the symptoms of mortification. How comes it to be thus distinguished from other animal matter in a state of sphacelus? If it be urged that in softening of the brain, the cerebral substance presents similarly exceptional characters, and yet is gangrenous, we reply that this too is hypothetical. And the objection seems to acquire further weight from the fact, that, in some instances, the destruction of cancer is accompanied with the ordinary appearances and symptoms of gangrene: this, we are aware, may be said to depend on implication of some of the natural tissues. Again, vessels are at no period more abundantly manifest in encephaloid than when softening has actually set in, a fact forming the chief groundwork of Lobstein's notion just referred to. Dr. Hodgkin endeavours to reconcile this fact with his own views by the hypothesis, that the observed vascularity is the result of "irritation which the softened part excites in the neighbouring parts, which still retain their life and organization." On the whole, the mode of softening of encephaloid (exclusive of that produced by hæmorrhage) seems to require further investigation.

The appearance of softened scirrhus is characteristic; it is that of a yellowish-brown semi-transparent gelatinous pulp, not unlike apple-juice, lodged in irregular cavities, the walls of which, free from membranous lining, present all the characters of firm scirrhus. The colour of the matter is liable to vary, from impregnation with blood.

The gelatinous contents of colloid cells appear to possess the same degree of softness at every period of their existence. The attempt made by Velpeau, to show that tissue of napiform, or solanoid aspect, forms the primary condition of colloid, is by no means successful. The softening and destruction of the mass must, therefore, depend simply upon the occurrence of these changes in the containing septa, the consequent rupture of the loculi, and escape of their contents. Opinions differ respecting the mechanism of this rupture. Cruveilhier conceives that the process resembles a gradual wearing out (usure), layer by layer, unaccompanied with any manifestation of vital activity ; and that when perforation is thus accomplished, effusion of the jelly-like matter follows. Müller, on the other hand, supposes, with greater plausibility, that when the growth of the subcells becomes extremely active, they burst their containing cells.

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[1] Rust's Magaz. b. xix. s. 229, 1825.

[1] According to Dr. Hodgkin, when the supply of nourishment is not promptly cut off by the operation of this natural ligature, the parts under the influence of such imperfect nutrition, instead of becoming gangrenous, gradually acquire an increase of density and ultimately become penetrated with "bony matter." It is not stated in what manner this observation was made.

The process of softening may commence in any part of a carcinomatous tumour, as well at the periphery as the centre. The notion of the constancy of *central* softening has been shown to be incorrect by careful observation. The change may originate in a single spot, or simultaneously in several.

The changes in the surrounding tissues accompanying this softening, lead to the elimination of the morbid growth. Inflammation and purulent infiltration are among the most important of these. Sloughing of the investing cellular membrane has, in some instances on record, completely disconnected cancerous tumours from adjoining parts, and led to their total expulsion ; a natural process of amputation, which has been observed in the instances both of scirrhus and encephaloid. When seated under the skin, cancerous growths either induce ulceration in that membrane, as the result of a languid inflammatory action, or distend it, and successively occasion atrophy from pressure, discoloration, diminution of temperature, of sensibility, and softening ; or, when the affected part becomes atrophous, as is sometimes the case with the mamma, irregular retraction, and puckering of the skin, follows; sulci are thus formed, become abraded, and constitute fissures, which gradually spread into ulcers. In any of these cases the skin may itself become cancerous. Perforation thus established, removal of the cancerous matter follows, either in the form of a liquid ichor, or in masses. The latter mode occurs not uncommonly in encephaloid, and leads to the formation of vast excavations with extraordinary rapidity. Professor Bérard refers to a cavity of this kind, sufficiently large to lodge the head of an adult. In the case of this product, there is usually an extreme disproportion between the length of time which precedes, and that which follows ulceration ; while the first may be of years' duration, the latter frequently lasts but a few weeks when death carries off the patient. Scirrhous ulcers, on the contrary, advance with comparative slowness, though occasionally proving rapidly fatal.

The appearance of the opening, or *ulcer* is, at first especially, in a great measure accidental. Its edges are sometimes thin, irregular, level with the surrounding surface, or, it may be sunken, undermined, and *inverted;* the latter condition amounting, in some cases, to a kind of reflection of the skin on itself. But this aspect usually changes, and the edges become elevated, and turned upwards and outwards, or *everted;* a state, which is of sufficiently constant occurrence to have been considered almost characteristic of cancerous ulceration. The surrounding skin acquires a bluish red tint to a variable extent round the sore ; and the excavated surface of the latter presents an irregular series of elevations and depressions, smeared with a thin watery matter, mixed with decomposed blood, or pulpy detritus, or studded with black patches of concrete hardened blood. The surface of a scirrhous ulcer is, however, sometimes dry, and of reddish, grayish, or brownish colour ; or, in other instances, covered with a stratum of soft and putrid fleshy substance generally, according to Trousseau, about one, or one and a half lines in thickness, and of the same colour as the surface of the sore. Underneath this layer hard scirrhus is discovered, to be in its turn converted into the detritus described, while the healthy parts, still more deeply-seated, undergo cancerous infiltration. The everted and elevated condition of the edge of carcinomatous ulcers, has been thus explained : the cancerous tissue underneath the border of the skin meets with no resistance on the surface next the sore, and, consequently, grows inwards towards the centre of the latter, at the same time sprouting upwards, in which direction also, it scarcely encounters any opposition ; the natural effect of this on the cutaneous edge of the ulcer is to raise it, and turn it outwards. On the other hand, the central portion of the tumour undergoes pressure from the peripheric portions, and its growth is proportionally obstructed. The absence of eversion is traced to inactivity of the subjacent cancerous matter. These particulars may be easily ascertained, by examining a vertical section of an ulcerated tumour ; the protruding marginal growths have a marked tendency to assume the pedunculated form.

Hæmorrhage frequently takes place from the surface of cancerous ulcers. In encephaloid such effusion is sometimes extremely abundant. M. Velpeau relates the case of an individual who lost nine pounds of blood in twelve days from an ulcer of this kind in the axilla[1]. Such hæmorrhage is extremely difficult to stop, has a constant tendency to recur, and eventually often proves fatal. In some instances the effusion is attended with a sudden sprouting forth of new growth. Extravasation of blood is less common on scirrhous surfaces, seldom becomes very abundant, and occasionally appears to produce a temporary improvement in the condition of the ulcer. The capillary tubes of the growth are its ordinary source ; but it may, as we have already said, originate in erosion of the larger vessels, or rupture of the varicose veins communicating with the ulcer.

The liquid ichor, or sanies, which forms the *discharge* from cancerous sores, is thin, acrid, and generally of a dirty green colour, but liable to variation in tint from admixture, in various proportions, with effused blood, or from impregnation with melanotic fluid, as in a case related by Rouzet. It possesses a peculiar, and almost characteristic fetor. It is said by some to effervesce with acids, and turn syrup of violets green; but Ploucquet found, on the contrary, that it exhibited the reactions of an acid. In warm countries, especially, generation of worms not unfrequently occurs in this matter [1]. There is nothing, however, peculiar to the cancerous discharge in such development, yet the fact seems to have led to the singular theory, already noticed, respecting the production of cancer by an insect. Valentin states his having discovered nuclear globules, and cartilage corpuscules in the " pus of a cancer;" but, according to Müller, such discharge is not peculiar to this affection, occurring, on the contrary, from all suppurating surfaces. To the similitude of pus granules, and nuclear epithelium cells, we have already adverted. The surface of the ulcer may participate in the kind of formation displayed by the whole mass: thus Müller has seen the white net-work of reticular carcinoma spreading into the minute asperities on the surface of fungating growths; in encephaloid, consisting of caudate corpuscles, the tailed appearance is found in course of development in the most superficial part of new vegetations. The same observer once saw a thick layer of polyhedral chole-steatomatous non-nuclear cells, forming a mass like tallow, on the surface of a cancerous ulcer in the mamma.

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[1] Rev. Méd. 1825, t. i.

Singularly as the fact clashes with the general laws of carcinomatous growths, it is no less true, that these products are not wholly incapable of *cicatrization*. Scirrhous ulcers occasionally assume a healthy vermilion tint, become covered with normal granulations, and actually cicatrize over a greater or less extent of surface. Abernethy relates a case of encephaloid tumour of the groin, in which, after the removal of a " portion of the tumour," the ulcer gradually " lost its inflamed aspect, granulations formed, and a cicatrix took place." M. Bérard witnessed a similar occurrence; and cerebriform cancer of the limbs and meninges has been known to cicatrize in the same manner, after inopportune incision. According to Bayle, the majority of scirrhous formations, in which this change is observed, are of a particular structure and character. Pouteau considered them the most intractable of all. Certain it is, that the amendment is delusive and temporary: the process ceases, and the disease advances with renewed activity. It must be understood, that we here refer solely to cicatrization occurring over actual cancerous substance.

The reappearance of carcinoma in the situation of its previous development, after the spontaneous separation, or artificial removal of a tumour, is unfortunately a most common occurrence. This *local reproduction* is effected in different ways. 1. The process of cicatrization may not distinctly commence, or be interrupted at an early stage, and fungating growths spring from some part of the wound. 2. A perfect cicatrix forms, and after a variable lapse of time, a tumour grows in the subjacent tissues, presses on the inodular structure, destroys it, appears externally, and on examination, presents the characters of carcinoma. 3. Reproduction may be accomplished in the tissue of the cicatrix itself, by the development of tuberiform, or infiltrated carcinoma.

To whichever species the original growth belong, the secondary formation is ordinarily encephaloid; hence, probably, the observation that consecutive, run their course more rapidly than primary, tumours.

§ 3. *Pathology*.

(A.) Reference has been made in a preceding page to the disproportionate frequency of cancer in some organs; for instance, the female mamma, the uterus, stomach, liver, and testicle. The cause of this particular proneness to the affection has naturally been made a subject of inquiry. Dr. Hodgkin conceives that, in respect of the genital apparatus of the female, the production of the disease is probably favoured by the intermitting and periodical variations to which the functional activity of the organs composing it is liable. But the comparative rarity of carcinoma of the ovaries, bodies participating in all the peculiar and sudden changes to which the other female organs are exposed, seems to shake very materially the plausibility of this doctrine; besides, the alternations of activity, and of total inaction, are still more frequent in the brain than in the genital apparatus, yet the cerebral substance is, comparatively, rarely visited with carcinomatous disease. According to the same writer, some parts appear to be predisposed to become the seat of cancer, in consequence of their being possessed of a low or imperfect degree of vitality; and the thymus gland, the supra-renal capsules, the mamma, and nævi materni, are adduced as structures illustrating the opinion. We are not acquainted with any facts proving that such predisposition exists on the part of the thymus gland, or renal capsules; and we believe with Rayer, that the disease has not been observed in the latter, unless as a coexistence with nephritic or hepatic carcinoma. The vitality of fibrous tumours falls vastly short of that manifested by accidental erectile tissue; yet we have seen the conclusion respecting the immunity of the former growths from cancer, to which clinical study has led very distinguished observers, and, on the other hand, noted the well-ascertained fact of the frequent development of carcinoma in the latter. And if low vitality be so favourable a condition for the production of the disease, how comes it, that of all the splanchnic viscera the stomach is most frequently carcinomatous? M. Cruveilhier, widely differing from Dr. Hodgkin, affirms that a superabundance of vitality and developmental energy exercises an unequivocal influence on the predisposition to cancer; an opinion quite as hypothetical as its converse.

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[1] Vacher, Diss. sur le Cancer des Mammelles, p. 81.

A very prevalent mode of accounting for the greater frequency of the disease in the mamma and testicle is by referring to their constant exposure to mechanical injury; the theory has spread from the schools to the vulgar, who almost invariably ascribing the affection to a blow or some other local violence, confirm in their turn the scholastic prejudice. Now in the majority of cases where such causation is voluntarily declared by the patients, or forced from them by the speculative pathologist, close sifting of their previous history distinctly proves either that the morbid growth had commenced before the receipt of the injury to which it is attributed, and that in truth the only relation between them is that the patient first discovered the diseased induration in looking after the effects of the blow; or that the occurrence of the accident is purely imaginary. We have in several instances assured ourselves of this. Besides, among other illustrations, if local injury play so important a part in evolving the disease, is it not fair to infer that carcinoma of the cervix uteri should be materially more frequent in prostitutes than in women of regular life? yet such is shown to be by no means the fact by the inquiries of Breschet and Parent Duchatelet, and by the experience of all Parisian practitioners who have had occasion, in an official capacity, to treat the former class of females on a large scale.

It follows from these considerations that the cause of the greater tendency of some organs than of others to cancerous deposition is unknown.

(B.) *Anatomical Course.*—(*a.*) The disease may, in its material manifestation, be confined to a single organ from the outset to the fatal termination; no organ but that originally affected presenting on post-mortem examination any traces of cancerous formation.

(*b.*) The disease originates in a single organ or tissue, whence it seems to spread, as from a centre, to a multitude of parts; the latter are said to be affected with *secondary* cancer. Now the mechanism by which the disease is propagated must obviously vary, according as parts adjacent to or distant from the primary growth are the consecutive sufferers. In the former case the propagation is effected by the progressive interstitial deposition or infiltration of the morbid matter in tissues naturally continuous or contiguous; or parts simply placed in juxtaposition or approximation may, according to Dr. Hodgkin, without the pre-establishment of adhesion contaminate each other. As instances of the latter mode of contamination, cases are referred to, in which an ovary, the mesentery or the liver being the seat of a malignant tumour, the parts in contact with it, whether convolutions of intestine or abdominal parietes, become similarly affected. In such instances, it might be questioned, adds this distinguished observer, and Rayer coincides with him, whether some principle, capable of deranging the nutrition of the part secondarily affected, does not pass by imbibition.

The occurrence of cancerous formation in distant organs, when an effect of pre-existing disease elsewhere, seems only intelligible as a result of transmission by the lymphatic or venous systems. The condition of the lymphatic structure in communication with a cancerous tumour varies. In some cases it is, to all appearance, normal; in the vast majority of instances, when the disease has existed for any length of time, the glands are affected with simple or cancerous induration[1], while the vessels leading to them are either filled with the heterologous matter, or, as is more common, no modification is discernible in their anatomical state. Now when the tubes are themselves loaded with cancerous substance, and are, for example, traceable so loaded from the diseased organ even to the thoracic duct[2], without any evidence existing of the matter being a product from the walls of the tubes themselves, the implication of the lymphatic system is evidently the result of absorption. But when the glands are cancerous and the connecting tubes in the natural state, the condition of the former is not thus so satisfactorily explicable. The difficulty may, it is alleged, be obviated by supposing the secondary formation induced by congestion of the glands, itself excited by the irritation attending the progress of the primary growth. We are at a loss to understand, why the vessels themselves, in closest proximity to the disease, should not suffer, were this conjecture well-founded: the analogy of common or venereal irritation will not fairly apply here. Maunoir observes that in the advanced stage of encephaloid, lymphatic glands unconnected with the tumour by vessels sometimes become affected, and Sir A. Cooper has seen the axillary glands of the opposite side diseased in cancer of the mamma. In these cases the lymphatic carcinoma must be admitted to occur independently of the existing growths, unless the statement of Scarpa, that the cancerous ichor sometimes passes circuitously along the anastomosing lymphatic vessels be well founded.

As it is necessary to admit that the process of absorption, as a part of nutrition, is constantly going on in cancerous growths, it may be inquired why distant contamination does not occur from their earliest deposition. A parallel case may be cited. The pyogenic membrane or enclosing cyst of abscesses is by all admitted to be an absorbing and secreting agent, yet in how few cases of abscess does pus find its way into the circulation. Both facts may be explained by supposing that these vessels normally exercise a decomposing action on the purulent or cancerous matter, which they cease to do on some occasions, admitting it then into their interior with its natural properties.

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[1] Of a mass of glands in connexion with a cancerous tumour, those nearest the latter are sometimes, it is said, found distinctly carcinomatous, while the more distant are simply enlarged from irritation.

[2] A. Cooper, Hourmann.

But the occurrence of secondary carcinoma, in localities free from lymphatic communication with the seat of a primary growth, remains to be explained. In these cases it appears hardly possible to doubt that the venous system is an agent of translation: while M. Cruveilhier affirms that such is the case with all the earnestness of conviction, Müller simply admits the possibility of the absorption and diffusion of the germinal nuclei giving rise to secondary formations. If it be true that we still want the material demonstration of this—if no investigator has yet discovered the cancerous matter actually *in transitu* with the blood in the veins leading from one diseased organ to another—still the following arguments may be adduced as affording strong presumptive evidence in favour of the reality of such transmission. 1. Cancerous matter exists in a multitude of cases in the veins of the diseased part; now this is obviously a most favourable circumstance for its circulation with the returning blood. 2. The rapidity of the successive development of the disease in different organs, sometimes observed, seems only producible by the agency of a fluid which, like the blood, pervades them all. 3. The liver and lung, the two organs in which foreign bodies introduced into the circulation are almost invariably observed to stagnate[1], are by far the most frequent seat of the secondary development of carcinoma. 4. Secondary cancer in the liver and lung occupies the same elementary seat as pus formed in those organs consecutively to the existence of suppuration in a distant part of the frame (metastatic abscesses.) The granules of the former organ are in both instances the element affected[2]. Dr. Carswell, arguing for the primary vitiation of the blood, affirms that the fact of absorption is disproved by minute anatomical details; but gives us no information as to the presumed nature of these. Dr. Hodgkin is persuaded that the consistence of the matter is sufficient evidence "of its not having been transported along the vessels in which it is found," (of course this applies *à fortiori* to secondary tumours in the parenchymata) and believes its existence in the veins and lymphatics to be the result of "inflammation of the malignant growth and the natural structures connected with it." The fact of inflammation occurring under these circumstances is unestablished; we shall presently recur to the objection founded on the consistence of secondary formations. According to Müller the presence of cancer in the venous capillaries "appears simply to indicate inflammation of those vessels:" a notion discordant with the well-established fact, that the morbid matter is found in perfectly healthy portions of the venous system.

Nevertheless some apparently serious objections may be raised to the doctrine of venous transmission. If such, it may be urged, be the mechanism of the production of carcinoma in distant organs, why is such production not a constant phenomenon? why should cancerous disease ever terminate the existence of individuals without having manifested itself *materially* in more than a single spot? A satisfactory answer cannot in the present state of the science be easily found. It must, however, be recollected, that the presence of the morbid substance in the veins has not been proved to be a constant condition of its existence in every form of the disease; secondly, that when the minute veins are blocked up, the circulation in the portions of tube immediately in front of the obstruction can only go forward by anastomotic communications; and that, thirdly, the morbid substance is in many instances completely cut off from the general circulation by sanguineous concretions. Of this last fact published engravings of carcinoma furnish examples. Another objection to this doctrine may appear in the multitude and large size of secondary formations; it is physically impossible, it may be alleged, that these should have been the produce of absorption from a mass, itself smaller than many among them, and which at no period of its growth suffered apparent diminution of bulk. But it is not meant in the remotest degree (and this is the answer to those who object to the origin of secondary carcinoma in absorption on the score of its consistence) that consecutive formations are composed of the actual substance of the primary mass, though even this does not seem, from the evidence of infinitely rare cases, to be impossible; the micrography of cancer shows that the translation and deposition of a few cells only from the original nidus might lead to the development of the largest mass; each cell is in itself *the possible embryo of a tumour.* There is yet another fact, apparently subversive of the notion of venous transmission. The detritus and ichor of carcinoma have been injected into the veins of animals, but no development of cancerous structure has resulted from the experiment. Granted, but this simply proves—and it does so perhaps as conclusively as any other adducible argument—the absolute necessity of predisposition for the production of the disease; without this even its material constituent manifests itself only as an irritative agent.

Some curious facts are to be found in authors which at least justify what has been just said respecting the *metastasis* of cancerous tumours. The following is an abridged account of one of these, related by Recamier on the authority of Parent Duchatelet. A woman, after having for a length of time suffered from a tumour in the breast possessing all the characters of non-ulcerated scirrhus, and presented the symptoms of the cachexia in so marked a manner that Dupuytren not only refused to remove the disease, but dissuaded M. Parent from the use of leeches, was seized with remittent cephalalgia of intolerable violence : at the same time the mammary growth ceased to be painful and disappeared almost completely. Apoplectic symptoms with hemiplegia supervened, were combated by the ordinary means, and recurred twice before the patient's death, which took place ten weeks after the first apoplectic seizure, and two years after the supervention of the symptoms in the mamma. On post-mortem examination a tumour the size of a nut, and possessing the characters of carcinoma, according to the testimony of Cruveilhier, was discovered floating, as it were, in a quantity of diffluent brain. The case is narrated with very satisfactory minuteness.

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[1] Cruveilhier, Magendie, &c.
[2] Cruveilhier.

The diseased condition of the *nerves* adjoining cancer, already adverted to, has been cited by Lobstein as affording proof that the affection may be transmitted to distant organs through the medium of those cords. This hypothesis has not sufficient plausibility to require serious examination.

Numerous writers, apparently in despair of discovering the true mechanism of secondary cancerous development, have, like our forefathers in respect of metastatic abcesses, contented themselves with the verbal subterfuge, that it is accomplished in virtue of the intimate physiological connexion or sympathy subsisting between parts. The mamma and uterus are adduced as organs exemplifying this mode of propagation of the disease. The illustration is singularly infelicitous. Those who have examined the bodies of many individuals dying with uterine cancer are aware that secondary development in distant parts is, comparatively, one of its rarest concomitants ; and that when such development takes place, the mamma is in the vast majority of cases spared. In a very considerable number of autopsies of females dying in all stages of uterine carcinoma, we have not observed a single instance of similar secondary growth in the mamma. The accurate Bayle declares, as the result of his experience, that the uterus is ordinarily perfectly free from organic disease in cases of fatal mammary scirrhus ; and this even in women who have towards the close of life had an abundant fetid vaginal discharge : the existence of such discharge has probably engendered the error to which we refer. Dr. Blundell, too, mentions[1] that he has never seen a coincident deposition in the mamma and uterus. Further, all are agreed in regarding the liver and spleen as intimately connected physiologically; yet so extremely rare is the coexistence of cancer in these organs, that Breschet not long since asserted that such combination had never, to his knowledge, been observed. Of eleven cases of cancer of the liver related in Andral's Clinique one only was attended with similar formation in the spleen; though in almost every instance there were other organs beside the liver affected with the disease. It is a curious fact, too, that in Velpeau's celebrated case, while the liver contained several hundred cancers, and hardly a part of the frame had escaped contamination, the spleen was unaffected. The liver was not affected in one half the cases of cancerous disease of the spleen we have found in authors ; and even if the number of cases were greater, it must be recollected that no matter where the primary disease exists, the liver, as has just been stated, is the organ most prone to suffer consecutively. These facts suffice to overthrow the doctrine of sympathy.

The question has arisen, whether any particular organs or tissues are incapable of becoming the primary seat of the disease. Individual experience can scarcely be expected to furnish a correct answer to a question of the kind. We have already exposed the fallacy of Scarpa's notions on this point. Dr. Carswell has never met with carcinoma of the pancreas, muscular, venous and arterial tissues, serous, mucous, and fibrous membranes, without the disease having been communicated from a neighbouring organ. But Bayle mentions his having seen primitive cancer of the pancreas in a few instances ; and he is not likely to have been mistaken in the nature of the affection, as he is at much pains to distinguish true scirrhus of the organ from other diseased indurations : M. Recamier also relates a case in which the pancreas was the sole organ affected. Secondly, though primary affection of the mucous membranes is extremely rare—the disease originating either in the subjacent cellular tissue, or in the muscular tunic, where such exists—yet we are disposed from our examinations of certain cancerous stomachs to believe with Scarpa, Cruveilhier, and others, that the morbid action commences occasionally with the mucous tissue. Thirdly, though cancerous tumours of the internal surface of the dura mater ordinarily originate in the cellular tissue between that membrane and the arachnoid, yet observers of eminence affirm that the morbid growth may sometimes be distinctly traced to the fibrous substance itself. Cancerous tumours are produced from the periosteum of the cylindrical bones, the latter being themselves perfectly free from disease: and sometimes encephaloid " splits the sclerotic into two lamellæ, distinctly originating in the interstitial substance of that coat."

Bayle states that the muscles of locomotion are not observed to be affected with primary cancer, in which respect they differ from those of organic life. The Fasciculi of Cruveilhier, however, prove that small cancerous masses may be developed secondarily in the muscles of animal life, without any direct continuity with the original disease ; and encepha-

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[1] Diseases of Women, p. 161.

loid originates even primarily in the same situation.

The tissues and organs which are very rarely affected primarily, may easily be enumerated without much apprehension of error: to this category would belong, in addition to the parts named by Dr. Carswell, the spleen, the larynx, the heart, and the lymphatic glands. It has indeed been a currently received opinion that the affection is always secondary in the last mentioned parts; that carcinoma is occasionally, however, exclusively developed in those organs, is a fact supported by the testimony of Walther, Wardrop, Travers, Recamier, Carswell, Littré, Warren, Jäger, and others. We are not acquainted with any instance in which the fibro-cartilaginous, ligamentous, or tendinous tissues have been found cancerous, except as a result of communication from a contiguous tissue.

Are there, on the other hand, any structures in which, though liable to become the primary seat of the disease, secondary development is not observed to occur? This query must decidedly be answered in the negative, more especially with regard to extension by contiguity of tissue. Secondary affection of some organs, as a result of its existence in distant parts, is nevertheless remarkable for rarity: M. Cruveilhier states that consecutive cancer of the ovaries is thus characterized; and secondary affection of the uterus is, though more frequently observed, still extremely uncommon.

Secondary carcinoma is, in the majority of cases, of the encephaloid species; scirrhus is, however, far from uncommon, and colloid has been met with. The disease under these circumstances usually assumes the disseminated tuberous form, especially in the liver, lungs, and bones. On the subpleural pulmonary surface it frequently manifests itself in the form of flattened cartilaginous-looking patches.

The consecutive development does not appear to spread from organ to organ according to any regular law. Published cases exhibit, on the contrary, every variety of combination of parts secondarily diseased. And in respect of the two organs most frequently thus affected, though the liver ordinarily suffers more extensively than the lungs, and though when the disease exists in both, its development in the former seems almost always (when the point is capable of decision) to have been prior to that in the latter, yet this is by no means invariably observed.

With respect to the relative tendency of different organs, when cancerous, to infect the economy generally, there can be little doubt that the mamma holds the first place. It is difficult to point out any special cause for this peculiarity; indeed in all probability none such exists. M. Cruveilhier conjectures that it may depend on the fact that even extensive disorganization of the mamma does not directly produce disturbance of any important function, a circumstance which allows the disease full time and scope for complete evolution. The justness of this suggestion could only be satisfactorily ascertained by comparing the mean duration of cancer of the mamma with that of other organs: these quantities are unfortunately unknown. Numerous *à priori* considerations might be urged against M. Cruveilhier's hypothesis. On the other hand uterine carcinoma rarely entails general contamination of the system; to such a degree is this true, that M. Cruveilhier makes it the ground for questioning whether in a case of coexisting encephaloid of the brain and of the pultaceous cancer of the uterus, the former, though—judging from symptoms—developed after the latter, in anywise depended on its prior existence. As the mean duration of uterine cancer appears from the inquiries of Mr. Lever to be about twenty months, the rarity of consecutive development in its course argues in favour of the opinion of the French pathologist just stated. This same experienced observer represents carcinoma of the rectum as being habitually unaccompanied with general infection.

The different species of cancer exhibit unequal proneness to the production of secondary growths. Observers agree in assigning colloid the lowest rank in this respect: that scirrhus holds the first would appear to follow from the fact that this is the species of far most frequent occurrence in the mamma. Nevertheless encephaloid tumours, especially as developed in the extremities, stomach, and testicle, may be said to possess superior influence. Numerical evidence on this, as on almost every other point in the history of carcinoma, is yet a desideratum. It is assuredly more common to find a number of organs in the same individual affected with encephaloid than with scirrhus: but it does not hence follow that the primary disease was of the encephaloid type, and many such cases of multiple formation may in truth belong to the category alluded to in the following paragraph.

(*c*.) The reader has probably felt inclined to ask, where is the proof that, in the cases of general infection adverted to, the growths which we have considered to be developed consecutively to another or others, really possess such relation thereto? Is it not quite as likely that, in some cases at least, the presence of heterologous growths in numerous organs may depend on their simultaneous development. Unquestionably such is the truth in a greater share of instances than the language of reporters of cases would lead us to suppose. There can be no doubt that internal cancer is frequently described as consecutive to an external one, (especially when the latter has been removed with the knife, and the former has not manifested its existence by symptoms until after the operation) when no proof of its not having co-originated with it can possibly be adduced. The fact of succession in the development of the disease seems only capable of demonstration (exclusively of cases of extension by contiguity of tissue) under the following circumstances: 1. when the morbid growth occurs in the skin, subcutaneous cellular membrane or other situations, where its origin and progress may be traced with the eye and hand; 2. when the lymphatic vessels and glands communicating with a diseased mass themselves become affected. While speaking in general terms we are obliged to exclude the condition of the heterologous matter and the existence of symptoms as elements for forming an opinion, although particular instances do arise in which either may be decisive of the question. Thus neither the size, the consistence, or the number of masses in a given organ will always throw any material light on the matter; their growth may have been slow or rapid, their consistence may be soft *ab initio*, a number of tumours may be produced within as short a period as a single accumulation. We obtain no more satisfactory guidance from symptoms; carcinoma may exist for a length of time in the most important organs—witness the brain, the liver, the lungs—without producing the least functional derangement; experience even proves that two-thirds of the surface of the stomach may be destroyed by cancerous ulceration without—provided the orifices are left intact—producing any general or local symptoms of sufficient intensity to direct the attention of the patient or his medical attendant to that important viscus.

(c.) The condition of the solids and fluids of subjects dying with cancerous disease has scarcely been investigated. Lymphatic and visceral secondary contamination are the only lesions recognised as attendants on the progress of the disease; whether any other exist, and bear the same relation to the original affection as the secondary lesions of phthisis discovered by the philosophic labours of M. Louis, remains to be ascertained. The materials for the inquiry can only be obtained by long and laborious clinical research.

M. Louis found that the mean volume of the heart was less in subjects dying from cancer, especially of the stomach and uterus, than in those succumbing under any other disease; and that while the aorta measures 34½ lines (Fr.) in width at the edge of the sigmoid valves in subjects dying of acute diseases between the ages of 30 and 40, and 32 in the victims of phthisis, it only measures 30 in carcinomatous subjects of the same age[1].

Tubercle and cancer rarely co-exist. In fifty-two autopsies of cancerous subjects collected from various sources we found but three examples of the anatomical characters of phthisis. The difference of the ages at which the two diseases are most prevalent would lead us to expect a result of this kind, independently of any influence which the formation of one may have in excluding that of the other form of morbid matter. It is worthy of remark, that in the three instances of coexistence referred to, the cancerous affection was of the scirrhous species, and the mean age of the subjects thirty-seven. The absence of tuberculous disease in all the cases of encephaloid (thirty-one in number) argues strongly against the opinion of those who either consider the latter allied to scrofula, or with Mr. Travers actually regard it as cancer modified by a strumous constitution: indeed we have never yet met with a solid argument in support of this doctrine.

The quantity of blood in circulation diminishes; and that what remains is materially altered in composition, the change of its colour, and of the solids it nourishes, and the undue proportion of serum in that effused in hæmorrhages, incontestably show; but the extent of this alteration, its precise nature, its relation to different stages of the disease, above all whether the microscopical elements of carcinoma mingle with the fluid, are all unknown.

(D.) ETIOLOGY. (*a.*) *Specific cause.*—Until of late years it was pretty generally believed that cancer might be transmitted from individual to individual by means of an inoculable or even an infectious principle. The grounds for the belief consisted on the one hand of a few ill-authenticated statements in the older writers respecting the development of the disease, in persons presumed to have been previously healthy, as a result of close and habitual contact with cancerous subjects; on the other of an experiment by Peyrilhe, in which that surgeon introduced some cancerous matter under the skin of a dog, and produced, as he implies, a carcinomatous ulcer. Admitting the authenticity of the first order of facts, they can only prove the fact of coincidence. As to the experiment of Peyrilhe, the only ascertained results were violent inflammation and gangrene; the ultimate effect was not known, as the animal was lost sight of.

The accurate observations of modern pathologists have settled this question in the negative. First, Alibert, Biett, and several pupils of the Hôpital St. Louis inoculated themselves with the ichorous discharge of cancerous ulcers without suffering any particular effect from the operation: Secondly, Dupuytren introduced pieces of cancerous tissue into the stomachs of animals[1], and injected the matter from ulcers into the veins and splanchnic cavities without producing any result except those caused by irritating substances generally: Thirdly, among a considerable number of men who had habitual intercourse with women affected with ulcerated cancer of the cervix (of which the existence was established by post-mortem examination) not one presented the slightest symptom of such disease[1] (Bayle): Fourthly, surgeons have frequently wounded themselves in the extirpation and dissection of cancerous growths, without suffering in consequence from carcinomatous disease. (Jäger.)

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[1] Rech. sur la Phthisie, pp. 54, 56. 1825.

[1] Gooch relates the "history of a cancerous disease, which arose from drinking some liquor impregnated with the matter that issued from an ulcerated cancer;" (Cases and Remarks, &c. p. 39.) but the inference drawn from this case is not justified by the narrative.

(*b.*) *Predisposing causes.*—To this class belong all conditions which are supposed to modify the organic state of individuals in such manner as to prepare them, as it were, for the influence of the direct causes of disease.

1. *Age.*—The different species of carcinoma may originate at every period of existence. In a remarkable case described by Billard[2] development of scirrhus had taken place in the heart during intra-uterine life; under the head of Meningeal Encephaloid we shall have occasion to refer to two cases in which that affection existed at birth; and Mr. Travers[3] has figured a remarkable specimen of congenital encephaloid of the eye observed by himself and Sir A. Cooper when the infant was eight months old; at birth the eyeball was as large as a walnut. M. Cruveilhier has, on the other hand, known uterine cancer manifest itself at the advanced age of eighty-four. The general sense of authors on this point, however, is that the disease rarely occurs in early life, seldom originates in old age, and is especially frequent in both sexes between the ages of thirty-five and fifty. As the accuracy of this notion had never been tested statistically, we felt desirous of supplying the very obvious desideratum in our knowledge of the general laws of the disease; and accordingly obtained permission to examine the returns of deaths supplied to the Registrar-General in pursuance of the late Registration Act[4]. In applying to this source there were some particular advantages not usually enjoyed by those who have endeavoured to determine the influence of age on diseases by statistical evidence: their cases have, with few exceptions, been collected in hospitals, consequently among individuals of a particular age, of a certain station in society, and usually exposed to *peculiar* influences destructive of health. The Registration includes persons of every rank and of every age; in using the documents it furnishes, we were consequently protected from numerous sources of error. Fortunately, too, for our present purpose, cancerous disease, before it proves fatal, exhibits its characters in so marked a manner, as to leave little apprehension of mistakes in diagnosis having occurred.

To the period of death, and not of development of the disease, the following tables of course immediately refer; but as the ages are arranged in decennial periods in our proportional tables, and the mean duration of cancer of all kinds, in all organs, and in subjects of every age, does not in all probability much exceed two years and a half, the error would be slight were the results applied to the period of development. Twelve hundred cases seemed sufficient for obtaining the rate and law of mortality; to this number we accordingly limited our extracts. Their mode of distribution is seen in the following table:—

TABLE I.

Showing the absolute mortality from Carcinoma in both sexes and at all ages.

AGE.	MALES.	FEMALES.	BOTH SEXES.
1 month			
2 ,, . .	. .	. 1	. 1
3 and under 6	. .	. 1	. 1
6 ,, 9			
9 ,, 12			
Years.			
1 ,, . .	2	1	3
2 ,, . .	1	4	5
3 ,, . .	. .	1	1
4 ,, . .	. .	1	1
5 and under 10	3	2	5
10 ,, 15	1	4	5
15 ,, 20	3	5	8
20 ,, 25	4	2	6
25 ,, 30	1	13	14
30 ,, 35	6	23	29
35 ,, 40	15	43	58
40 ,, 45	19	77	96
45 ,, 50	23	98	121
50 ,, 55	34	130	164
55 ,, 60	35	120	155
60 ,, 65	44	110	154
65 ,, 70	45	88	133
70 ,, 75	35	69	104
75 ,, 80	30	49	79
80 ,, 85	16	28	44
85 ,, 90	1	8	9
90 ,, 95	2	1	3
95 and upwards	1	. .	1
Totals	321	879	1200

From this table we learn the proportional numbers of individuals dying from carcinoma at each specified period of life; but were we to conclude that these numbers represent the relative tendency to the disease at different ages, we should fall into a very serious error. It appears for example that 250 females die of cancer between the ages of 50 and 60, while 118 perish between those of 70 and 80; but if the total number of females living of the former age were double that of those alive of the latter, the proportional mortality at both decennial periods of life would be as nearly as possible equal, instead of being in one of them double that of the other. In a word, in order to ascertain whether particular ages exercise any influence on the development of the disease, we must compare the absolute mortality with the total number living at each age. This we have been enabled to do from the population estimates of Mr. Rickman[1], and present the reader with the result in the following table :—

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[1] In a single instance only, an eruption of small pimples occurred at the extremity of the penis immediately after coition, but it disappeared spontaneously in a few days, and differed in nowise from the eruption occasionally produced by acrid leucorrhœal discharge.

[2] Traité des Maladies des Enfans, Pl. viii. Fig. 2. 1828.

[3] On Dis. of the Eye. Pl. v. fig. 2.

[4] For the Registrar-General's permission, we are indebted to the obliging interference of Mr. Farr, and seize the opportunity of expressing our gratitude to that gentleman not only for this kindness, but for several suggestions regarding this branch of our subject.

TABLE II.

Showing the proportion of deaths from Cancer in 1000 *living of each sex at the different ages.*

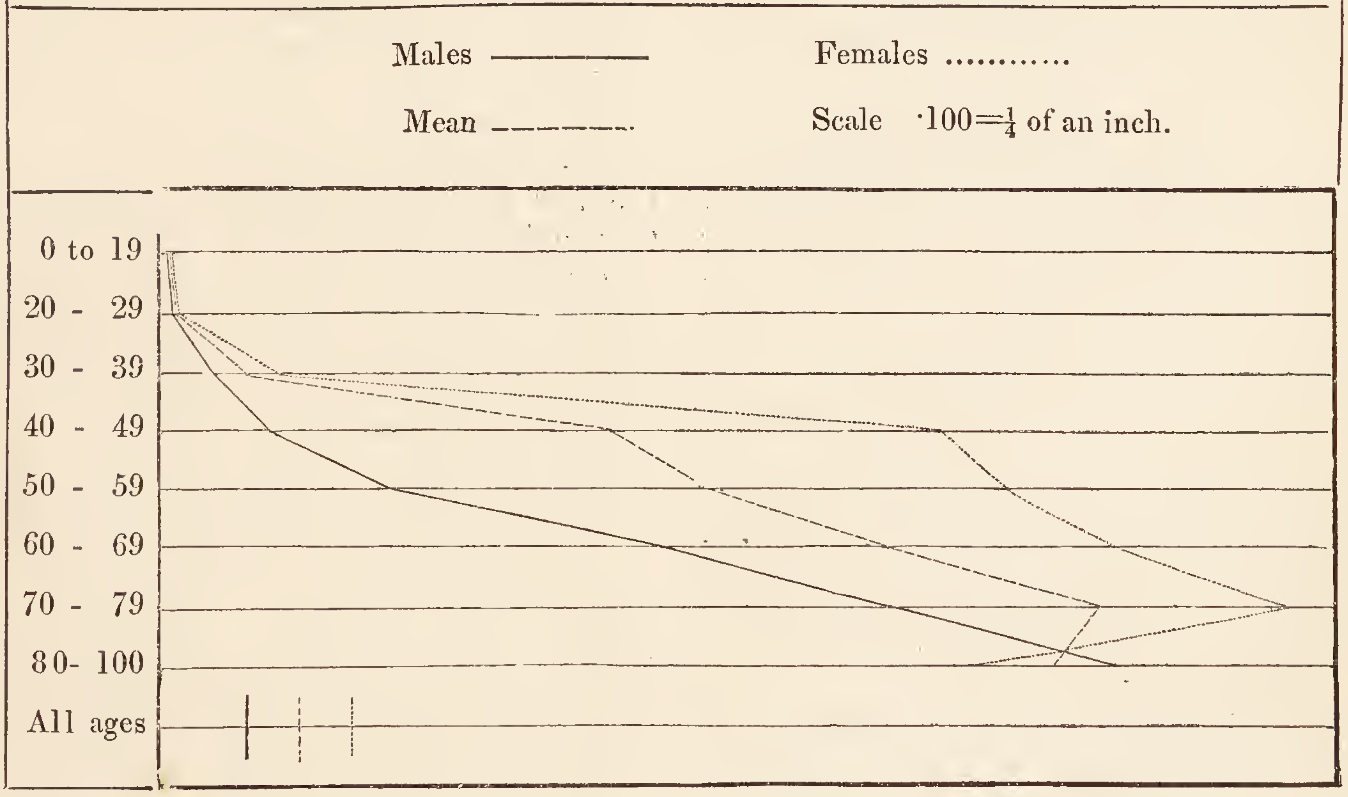
AGES.	MALES.	FEMALES.	MEAN.
Under 5	·006	·017	·012
5 and under 10	·007	·004	·006
10 „ 15	·002	·010	·006
15 „ 20	·009	·017	·013
20 „ 30	·010	·024	·017
30 „ 40	·058	·152	·105
40 „ 50	·140	·983	·561
50 „ 60	·290	1·066	·678
60 „ 70	·636	1·192	·919
70 „ 80	·935	1·421	1·178
80 „ 100	1·207	·973	1·089
All ages	·103	·245	·174

A glance at this table will suffice to show the inaccuracy of the commonly received opinion, that the tendency to cancer reaches its maximum between the thirty-fifth and fiftieth years. The mortality, on the contrary, goes on steadily increasing with each succeeding decade until the eightieth year ; after that period the results are, from causes which it is needless to enumerate, liable to slight error, and may therefore be omitted in the general survey. It is remarkable that the mortality from this disease is lowest at the same period of life as the general mortality from all causes indiscriminately, namely from the tenth to the fifteenth year.

The law of mortality differs strikingly in the two sexes ; the most general character of this difference being the greater regularity of increase with advancing age among males. Passing over the first twenty years, at which period the number of cases is probably too small to admit of very useful comparison, we find, it is true, that the number of deaths from æt. 30 to 40 is in both sexes about six times greater than from æt. 20 to 30 ; but here the similitude of increase ceases : in the next decennial period the deaths among females augment more than sextuply, while the mortality of males only increases two and a half times, &c.

These facts are, we trust, rendered easily comprehensible by the following diagram constructed on the plan recently employed by Mr. Farr in demonstrating the law of mortality in epidemic cholera. Number is here represented by space.

Diagram, reduced from Table II. showing the relative Mortality from Cancer at different ages in both sexes.



The fact likely to be most strongly impressed on the reader by this diagram is the enormous and abrupt increase of female mortality between the ages of thirty and fifty ; an increase which accounts for the erroneous notion that the disease reaches its maximum frequency at that period of life, and lends support to the current belief respecting the connexion of uterine and mammary cancer with declining activity and cessation of the genital functions. We have ascertained the apparent reality of their connexion still further by comparing our results with a table showing the intensity of fecundity of women at the different periods of life in Sweden and Finland[1]: from this curious document it appears, that the intensity of fecundity, which had been pretty uniform from æt. 25 to 40, suddenly falls to $\frac{1}{5}$ of its previous amount from æt. 40 to 50.

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[1] Rickman, *Population Abstracts*, vol. i. Preface, p. 38. Table II. was calculated by assuming as a basis the annual rate of mortality from cancer in 1837, then deducing from Table I. the relative proportion of deaths from cancer at decennial periods of life, next ascertaining from the population returns the relative numbers living at those periods, and dividing the former by the latter. Thus the female deaths from cancer at the age of 20 to 30, divided by the number of women living at that decennial period gave ·024 per 1000,—the relative mortality from cancer at that age. There are some other intermediate steps in the calculation, which it is not necessary to state particularly.

The *mean age* of the 1200 cancerous subjects at death was 59·4 years in the male sex; 56·1 in the female.

The different species of cancer are far from being equally common at all ages: scirrhus is essentially a disease of adults, while encephaloid is the form usually assumed by the morbid growth in young subjects; colloid appears so far to have been only observed in adult individuals.

Again, the locality of carcinoma is manifestly somewhat under the influence of age. Previously to puberty, the disease is most common in the eye, the lymphatic system, the brain[2], and the cellular membrane of the extremities; the uterus, mamma, stomach, liver, intestines, and bones enjoy comparative immunity until the thirtieth year. Exceptions to this rule are no doubt met with; Dr. Carswell is of opinion, that the exceptional occurrence of the disease during infancy or early youth in the latter class of organs depends upon their premature or præternatural functional excitement, and the statement appears to hold good in respect of the uterus, testes, and ovaries.

2. *Sex.*—The relative frequency of the disease in the two sexes may be learned from Mr. Farr's published tables of the causes of death throughout England and Wales during the last half-year of 1837[3]. Of 1228 individuals who died of carcinoma during that period, 355 were males, 873 females. Though a certain degree of numerical superiority exists on the side of the female population, yet it is quite insufficient to account for the much higher quota of cancerous deaths in that sex; for, by calculating the rate of mortality in proportion to the numbers living of each sex, we learn that the annual mortality from the disease is ·103 per thousand in males, and ·245 in females: the excess on the side of the latter is therefore as nearly as possible as 2·5 : 1. This difference is the more remarkable, from the fact that the mean rate of mortality from all diseases is 20·8 per thousand among males, while it is 19·7 among females.

3. *Temperament.*—Of 44 cancerous subjects, whose original constitutional bias was sufficiently marked for purposes of observation, 20 were of lymphatic, 12 of sanguineous, 8 of bilious, and 2 of nervous temperament. This numerical result, obtained from personal observation by M. Ferrus, has been since quoted as decisive of the influence of the lymphatic constitution on the disease. But (setting aside the smallness of the numbers from which the conclusion is derived) no inference of any kind can be drawn from them; as the proportional frequency of the different temperaments in the individuals forming the floating population of the hospital, where the cases were observed, is not known. And indeed as the hospital in question, the Salpêtrière, receives female patients only, in whom the lymphatic temperament is probably the most usual, unless such temperament were actually prophylactic against carcinoma, the result could be none other than that obtained by M. Ferrus. Connected with this opinion is the notion, likewise unproved, that encephaloid is of most frequent occurrence in scrofulous subjects.

Sabatier conceived he had ascertained, from the experience of years, that women of high colour and sanguineous temperament were more subject to mammary cancer than those of different constitution[1]. Mr. Lever has numerically proved a similar position in respect of carcinoma of the uterus[2].

4. *Habitation of town or country.*—Among the few positions stated by Breschet to be thoroughly established respecting the etiology of cancer is the following: "this disease is as rare among persons employed in agriculture, and the country population generally, as it is common among the lower orders of the population of large towns."

The soundness of this doctrine may be tested by the tables of Mr. Farr. From these we learn, that in the metropolis 185 deaths occurred from cancer, while five counties of nearly equal population, Cornwall, Dorsetshire, Devonshire, Somersetshire, and Wilts, furnished 126 deaths from the same disease. But the excess, on the part of London, is not even so marked as would on first sight appear; for, calculating from the estimated populations in October, 1837, the annual mortality is ·206 per thousand in the capital, ·143 per thousand in the counties. And, again, the number of deaths from this affection in a number of our principal manufacturing towns (Leeds, Liverpool, Manchester, Sheffield, &c.), with a total population of 1,762,710, exposed *per eminentiam* to what are esteemed the insalubrious conditions of the life of town artisans, is 152; while in a number of rural districts, containing 1,776,980 souls, 163 individuals fell victims to the disease. Finally, comparing the deaths from cancer in the metropolis and provincial towns on the one hand, with those in all the rural districts referred to on the other (337 in the former, and 289 in the latter), we obtain an annual mortality of ·189 per thousand in large towns, and of ·165 in the country. The character of this result is rendered more distinct by comparing it with the rate of mortality, from all diseases indiscriminately, in the same towns and counties: the annual mortality in the former is 27 per thousand; in the latter 16·9 per thousand, showing a remarkable minority in favour of a country life.

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[1] This, which is we believe the only table of the kind in existence, may be seen in Milne on Annuities, vol. ii. p. 582. It is highly probable that the law of fecundity is the same in this country; at least the period of menstruation is sufficiently close in the two latitudes to render the existence of any material difference in this respect exceedingly unlikely.

[2] Cruveilhier affirms that cancer of the brain is the "apanage of advanced age;" but Andral gives a table of forty-three cases, among which eight occurred before the twentieth, and eighteen before the thirtieth year. (Clinique Médicale, t. v.) Dr. P. Hennis Green has recently published a case of encephaloid of the brain occurring in a child aged twelve. (Lancet, Feb. 15, 1840.)

[3] First Annual Report of the Registrar-General, &c. Appendix P. 1839. 8vo edition.

[1] Médecine Opératoire, t. ii. p. 276. Parr (Dict. in voc.) affirms that he encountered the disease most frequently in persons of dark, cadaverous, and blue-brown complexion! Rather a singular union of tints.

[2] Med. Chir. Trans. vol. xxii. 1839.

Hence it appears that a town life is far from exercising any serious influence on the production and mortality of cancer. And if the fact be taken into consideration, that many cancerous subjects, who have acquired the disease in the country, remove, as an *ultima spes*, to the large town in their vicinity for the sake of the professional aid it affords, die and are registered there, and consequently swell the sum of deaths from the disease in cities, while they, *pro tanto*, diminish it in counties, the innocuousness in this respect of a city habitation, will appear in still stronger relief[1].

A curious fact connected with the question of metropolitan and provincial frequency of cancer is, that females furnish the excess in towns, whenever such excess occurs; this is seen in the following table:—

	Metropolis and Towns.	Counties and Rural Districts.
Males.	45	42
	29	53
	—	—
	74	95
Females.	140	82
	123	110
	—	—
	263	192

A number of *à priori* ways of explaining this peculiarity might easily be advanced, but the reader will probably agree with us in the propriety of suppressing any such hypotheses. One thing is certain, that the law in respect of cancerous diseases differs from that regulating the sexual ratio of general mortality in towns and country. The following numbers, representing the total deaths in the cities and counties referred to, show that the mortality of the former exceeds that of the latter by very nearly the same amount in each sex.

	Cities.	Counties.
Males	24,402	14,841
Females . . .	23,551	14,852

The *share of the total mortality caused by cancer, in the cities and the country* comparatively, is exhibited in the following table:—

	Population in October, 1837.	Total specified Deaths.	Deaths from Cancer.	Propor. in 1000 Deaths.
Towns . .	3,553,161	46,849	337	7·193
Counties	3,500,750	28,036	289	10·308

This result is exactly of the kind we might have expected: as the number of deaths from diseases, propagated or increased in severity by the insalubriousness of large towns, is necessarily less in rural districts than in cities, the proportion of deaths, from affections not thus influenced, must be higher in the former than in the latter.

5. *Habitation of a densely-peopled locality.*—The influence of concentration of population is evidently null; in the metropolis there are 25,758 individuals to a square mile; in the counties, with which it has been compared, only 222,—a ratio completely out of proportion with that of cancerous disease in the two localities.

In order to elucidate this point further, we extracted from the registers 470 deaths from cancer occurring in the metropolis, from July 1, 1837, to December 31, 1838, and arranged according to the Unions in which they took place. By collecting the Unions into three groups, ascertained by Mr. Farr to present different degrees of general salubrity, it will at once appear whether cancer follows the same law, in this respect, as others of the most destructive maladies. The absolute number of cases is given in the following table:—

Thirty-one Unions.	Deaths from Cancer.		
	M.	F.	Total.
A. 10 most unhealthy . . .	14	82	96
B. 11 of medium salubrity .	36	103	139
C. 10 healthiest	46	189	235

But as the estimated population of these three districts, in March, 1838 (the middle point of the eighteen months during which the cases occurred), were respectively 517,288, A; 505,746, B; 787,785, C; it follows that the annual deaths from cancer were, in district A, ·123; in B, ·183; and in C, ·199 per thousand living. Hence the mortality increases with the salubrity of the locality; a result which is rendered more startling by comparing it with the calculations of Mr. Farr, of the annual mortality from all diseases, from typhoid fever and from phthisis in the same districts[1].

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[1] The general result above given is, we are enabled to state, confirmed by the registration of 1838.

[1] Loc. cit. p. 113.

Districts.	No. of square yards to one person.	Annual general rate of mortality per 1000.	Annual rate of mortality per thousand from		
			Typhoid Fever.	Phthisis.	Cancer.
A	57	33·21	3·24	4·78	·123
B	78	28·39	2·05	4·51	·183
C	219	21·63	1·07	3·54	·199

It is not meant to be deduced from this table that general salubrity is favourable to the production of cancer, but it clearly follows from it that the influences increasing the mortality from disease in general, and from typhoid fever and phthisis in particular, (several other affections might be added to these) exercise no such influence on carcinoma. It may perhaps be conjectured that the high quota furnished by the West-End Unions (C) may be caused by the greater prevalence of the disease among the easier classes of the community; but if the table we give elsewhere of the social position of cancerous patients possess no other utility, it at least is useful in the refutation of this notion,—the large share of individuals belonging to the lower orders is there distinctly shown, and both results are drawn from almost exactly the same series of facts. The number and extent of hospitals in each district are sufficiently equal to require scarcely any correction on this score.

6. *Trade or occupation.* The broadest division of occupation, in a hygeinic point of view, is into those connected with agriculture on the one hand, and with trade, manufactures, and handicraft on the other. It may not be without utility to inquire, as far as available documents enable us to do, into the relative liability of individuals belonging to these great divisions of society to suffer from cancerous diseases. This has not been done by the comparison of towns and rural districts, for numbers of individuals engaged in agricultural pursuits may be inhabitants of towns, and *vice versâ.* We shall select for this comparison Birmingham, as furnishing the greatest excess of trading over agricultural families, and a division of the kingdom, comprising Cambridge, Huntingdon, and the southern parts of Lincoln, as exemplifying the converse condition. Calculating from the populations estimated approximatively for the period in question, the annual mortality from cancer in Birmingham—when the families engaged in trade and artisanship are *sixty-nine* times more numerous than those employed in agriculture—is ·224 per thousand; while in the rural districts enumerated, where the latter class of family is about double as numerous as the former, it is ·178. The advantage appears somewhat in favour of agricultural pursuits on first view; but the lower rate of mortality is evidently quite out of proportion with the vast relative minority of manufacturing families in the country districts.

	No. of families employed in			Deaths from Cancer.
	Agriculture.	Trade, Manufactures, Handicraft.	Other families.	
Birmingham.	301	20,763	2,870	14
Counties named.	35,105	18,813	13,433	30

In the mining districts of Staffordshire, Shropshire, Worcestershire, Northumberland, and Durham, of which the combined population in 1831 was 542,398, the deaths from carcinoma were 42 in six months; so that ·155 per thousand of the inhabitants perish annually from that disease. This is the lowest proportion yet noticed, and it would be still lower if we were enabled to calculate from the real population furnishing the deaths, namely that of 1837. Nevertheless, a large share of these people are constantly exposed to the influence of impure and damp air, and defective insolation. The remarkable longevity of the inhabitants of Durham generally, as shown in Mr. Farr's tables[1], may in some measure account for the comparatively small annual amount of cancerous deaths[2].

M. Benoiston de Chateauneuf[3] has shown, in a paper on the mortality of the French infantry, that, out of a total number of 4915 deaths occurring in six years in a military body 723,741 strong, 33 were from "cancer and ulcers." Hence the annual mortality is only ·045 per thousand from those affections; and 6·71 per thousand of the total number of deaths are thus produced. Now the rate of mortality from cancer among civilians is at least as high in France as in England. The cause of the apparently very low proportion in the army is, however, easily explained. The age at which youths are eligible for the conscription is 21; when enlisted they are obliged to serve six years (if in the infantry) and then given their *congé*—the mean age of the great majority of foot soldiers is, therefore, twenty-three and a half. Now on referring to Table II. we find that the rate of mortality per thousand among English male civilians from 20 to 30 is only ·010; hence the chances would appear considerably against, instead of being in favour of, a military life in respect of this disease. But other causes may contribute to produce this result—and the exact signification of the word "ulcers" is of course doubtful.

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[1] Loc. cit. Appendix Q.

[2] The valuable observations of Dr. Forbes on the diseases of miners substantiate the inference in the text. Although "there is an extraordinary superiority in the rate of mortality in the mining parishes over the agricultural and even those containing towns and crowded villages," this superiority evidently does not in any degree spring from the prevalence of cancerous disease. (See *Provincial Med. and Surg. Transactions*, vol. iv. p. 215.) The mean duration of life appears to be materially lower among miners than other labourers; this must have some influence in lessening the frequency of cancer among them.

[3] Annales d'Hygiène, t. x. p. 239, 1833.

In the hope of throwing some light on the influence, if any, of particular kinds of occupation, we noted the trade or profession of 650 individuals as stated in the registers. The result is now laid before the reader. We have grouped together all working artisans into a single class; and individuals gaining their livelihood by labour into another; wives and daughters are ranked according to the occupation of the husband or father. This method of arrangement is justified in respect, at least, of the social position of the subjects.

MALES.		FEMALES.		Totals.
Gentlemen[1]	9	Ladies[1]	45	54
Servants	7	Servants, 36, Nurses, 8, Midwives, Dairywomen, 1	45	52
Labourers, 94, Miners, 3, Sweeps, 3	100	Labourers Laundresses	94 17	211
Paupers	3	Paupers	27	30
Artisans, 60, Hatter, 1	61	Artisans, 17, and Wives, 40, Dressmakers, 7	64	125
Farmers	41	Farmers, or Wives of	29	70
Shopkeepers, 14, Auctioneer, 1, Merchants, 3	18	Shopkeepers, 25, Police Officers' Wives, 3	28	46
Tavern-keepers	4	Tavern-keepers	5	9
Sailors, 9, Fishermen, 4	13	Fishwomen, Sailors' Wives	14	27
Schoolmasters	3	Schoolmistresses	7	10
Soldiers	3	Soldiers' Wives	2	5
Clerks, Accountants	6		...	6
Players	2		...	2
Surgeons	2		...	2
	272		377	649

No conclusion of a satisfactory kind, however, can be drawn from this table until the relative proportions of individuals living in each position or trade referred to, at the period these cases occurred, has been ascertained. Now no materials exist for the establishment of this preliminary point; and there are other conditions—of which it is next to impossible to express the influence numerically—which render the establishment of the influence of profession on disease in general, one of the most difficult and least certain points of medical statistics. We may, however, we think, justly conclude from this table that the operative classes of the community furnish a fair proportion, at least, of the general mortality from the disease. The quantity of death produced by cancer in proportion to the total mortality is greater among the higher than the lower orders: this we have ascertained by comparing in the following table the proportion of cancerous death among individuals assured by the Equitable Society, who all belong to the better ranks, with that furnished by the total specified mortality of England and Wales among people of every station.

	Total Mortality.	Mortality from Cancer.	Mortality from Cancer in 1000 deaths.
Persons assured in the Equitable.	4,095	43	10·5
Population of England and Wales.	141,607	1,228	8·6

But this by no means proves that the quantity of cancerous disease is greater in the higher walks of society than in the lower. The wealthier portion of the population—that assured in the Equitable—suffers infinitely less from the epidemic and contagious diseases generated by "entassement" and the evils of atmospheric impurity than the poor; the former therefore are more open to the slow destruction of cancer. Besides, the selection exercised by the Assurance Companies, excluding deaths under twenty years, and consequently a vast mass of the population scarcely liable to suffer from cancer, reduces the mortality from the febrile exanthemata to a mere nothing, and lowers that from phthisis by more than half[2]: all these circumstances tend to increase materially the quota of death from cancer among the assured.

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[1] By these terms are meant, it is to be presumed, independent persons, or those who follow no particular trade or profession.

[2] See Farr's Vital Statistics, p. 588.

7. *Preexisting state of economy.*—Various writers affirm that a syphilitic taint of the constitution facilitates cancerous formation, even in organs unconnected with those primarily affected with the venereal poison. This is an assertion of which we have not been able to discover any solid proof; the comparative immunity of prostitutes from the disease in the organs most likely to suffer, militates against its accuracy.

It is difficult for many reasons to ascertain whether the married or single state is most favourable to the development of the disease in females. Among 172 persons whose matrimonial condition we extracted from the registers, we found 17 spinsters, 84 married women, and 71 widows. But as the proportional number of females belonging to each of these classes in England has not been ascertained, these absolute numbers cannot lead to an accurate decision of the point. If, however, acting on the supposition that the proportions are pretty equal in different European countries, we take those ascertained by census for the Parisian population, and compare them with our deaths from cancer, we obtain the following results, which may be looked upon as an approximation to the truth: of the unmarried ·07; of the married 0·48; of widows 1·32 per thousand die from carcinoma. But these proportions are probably mainly influenced by the mean *age* of the different classes of women furnishing them.

8. *Mental affliction.*—Much has been written on the influence of moral misery, sudden reverses of fortune, and habitual gloominess of temper on the deposition of carcinomatous matter. If systematic writers may be credited, these constitute the most powerful cause of the disease. M. Lobstein, assuming the fact as established, exercises his ingenuity in tracing the connexion of cause and effect; moral emotions produce defective innervation; this, perversion of nutrition, which in its turn causes the formation of carcinoma: the catenation is singularly clear. But though we doubt the lucidness of this explanation, and affirm that mental depression has not been *proved* to exercise the alleged influence, we are far from denying that facts of rather a convincing character in respect of the agency of the mind in the production of this disease are frequently observed. It should, however, be recollected that cancer is a very rare affection before the thirtieth year, and that the number of persons fortunate enough to reach that age without having suffered under disappointed hopes and wasting grief, is, in all probability, comparatively small. Authors who dwell most strongly on this mode of causation of the disease, curiously enough fix on the middle ranks of society as those furnishing the least amount of cancerous disease, yet these are precisely the classes in which reverses of fortune must most frequently occur, and in which the mental anxiety inseparable from professional and commercial pursuits must be strongest and most lasting.

9. *Intellectual labour* has been speculatively set down as a predisposing cause of cancer; but we have been unable to discover any sound motives for the opinion.

10. *Climate.*—On the influence, if any, of climate in the production of this disease we have nothing of a satisfactory kind to offer. Mason Good mentions its being a matter of general agreement that the disease is more frequent and more virulent in the high northern latitudes than in the southern regions of Europe: but the grounds for this uniformity of opinion are not stated. Professor Otto in his recent elaborate essay on the medical topography of Copenhagen[1] makes no mention of the disease.

Out of the population of Paris in 1830, amounting to 770,286 souls, there were 602 deaths (112 males, 490 females) from "scirrhus and cancer;" this gives a mean annual mortality from those affections of ·781 per thousand—nearly four times as great as that of London[2]. Of a total number of 30,102 cases admitted into the Hobart-town Hospital during twelve years, there were but four cases of "scirrhus[3]." In the pages of the Calcutta Medical Journal we occasionally find a passing remark on the infrequency of scirrhus and encephaloid among the Hindoos; but probably these observations are little more than mere matter of surmise.

11. *Hereditary Transmission.*—The question whether the disease is transmissible from parents to their offspring is one which has repeatedly been mooted and decided chiefly on theoretical grounds, or from very limited observation, in the affirmative and negative alternately. Whatever be our general theory of hereditary influence, a satisfactory conclusion regarding its connexion with cancerous disease can only be obtained by the well-advised application of the numerical method. The only absolute demonstration of its reality would be the discovery that of a large mass of cancerous individuals a very considerable majority were born of parents similarly diseased; and that of a like series of subjects unaffected with carcinoma, a small minority, at the most, sprang from a cancerous father or mother. Additional confirmation of the fact would be had, were it proved that the mean period of manifestation of the disease were materially earlier among cancerous individuals born of parents similarly affected, than among persons of untainted parentage. While, however, the existing want of satisfactory proof of the hereditary origin of carcinoma is incontestable, the presumption

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[1] Prov. Med. and Surg. Trans. vol. vii. 1839.

[2] Journ. Complém. du Dict. des Sc. Méd. t. 41. p. 440.

[3] Scott, in Prov. Med. and Surg. Trans. vol. iii, 1835.

in favour of such origin is, on the other hand, strong enough to justify the practitioner in acting as if its existence were matter of demonstration, especially as no evil can accrue from his doing so[1]. (See the observations on Prophylaxis.)

The occurrence of cancer in the fœtus in utero may be by some regarded as evidence of the hereditary character of the disease: unfortunately authors have left us no account of the state of the mothers' health.

(*c.*) *Exciting causes.*—These are either mechanical, chemical, or vital.

1. *Mechanical.*—The influence of mechanical violence in the immediate production of cancerous disease is very generally admitted. Indeed, making full allowance for the sources of fallacy already referred to, the number of instances in which the disease appears, as far as it is possible to judge, to have originated some short while after the receipt of local injury, seems to render the occasional reality of such influence hardly controvertible. But numerical results are wanting to show the relative frequency with which this cause operates; in the vast majority of cases in which blows are received, no such disastrous consequence follows, nor has any precise information yet been obtained as to the conditions which cause the same species of injury to produce in one person common inflammation with purulent secretion, in another chronic induration, and in a third lead to the deposition of carcinomatous matter.

Observation disproves, as we have seen, the general importance of local violence in the production of uterine cancer. Evidence of the same kind exists in respect of the brain; of 43 cases of cerebral carcinoma, collected by M. Andral, two only had followed injury to the cranium. Chardel relates the case of a hatter whose trade obliged him to lean forcibly with the epigastrium against a board, and who ultimately died of cancer of the stomach; an event ascribed to the irritative pressure. But he forgets the multitudes of hatters, whose epigastria undergo similar rough treatment, and who notwithstanding descend to the grave with a sound stomach. There is on the other hand an account by Baillie of a case in which a mechanical irritant (five halfpence) had been lodged for a considerable period in the cavity of the stomach, and given rise to the formation of an adventitious cyst, without inducing the least cancerous formation. Of the bearing of these facts we shall presently speak. In connexion with this subject may be noticed a curious crotchet of M. Recamier. This pathologist declares his persuasion that the mere circumstance of a blow being aimed at the stomach may give rise to the disease—that an individual frightened by a gesture imitating a blow, suffered in consequence from "epigastric anxiety," and consecutively from cancer. In the dark ages of military surgery the wind of cannon-balls worked marvels; but these sink into insignificance in comparison with M. Recamier's "attempt at a blow."

2. *Chemical.*—Some years since M. Bouillaud published a case of scirrhous induration of the pylorus, occurring in an individual who had suffered from gastritis caused by swallowing a quantity of nitric acid. The case is cited in evidence of the inflammatory nature of cancer. But, in the first place, we would ask, where is the proof that the cancerous affection had not existed before the ingestion of the poison? And, admitting the reality of the alleged causation in this instance, that the conclusion *à particulari ad universale* is here singularly illogical is shown by such facts as the following, observed by Laennec, Dupuytren, and Tonnelier. A girl unexpectedly recovered after swallowing a quantity of arsenious acid, but repeating her attempt at self-destruction a year afterwards, succeeded. In addition to the anatomical effects of the poison just taken, a cyst about the size of a goose's egg, evidently separated recently from the pyloric region, was discovered in the interior of the stomach. The contents of this cyst were on analysis by Vauquelin found to be an ounce of crystallized arsenious acid. No appearance of carcinoma was anywhere detected[1].

The action of spirituous liquors indulged in persistently and to excess may be considered somewhat allied to that of irritant poisons; and numerous authors assert that the disease is frequently induced in the stomach by the habit of drunkenness. But no proofs are given of the assertion, and it is contradicted by the fact, that although the stomachs of persons dying with delirium tremens occasionally present the anatomical characters of chronic gastritis, the deposition of carcinoma in that organ has not, so far as we have been enabled to ascertain, been noticed under the circumstances. Besides, how trifling is the proportion of sufferers from gastric cancer to that of habitual drunkards; and how comes it that it is at least as frequent in the sex almost exempt from delirium tremens as among males[2]?

3. *Vital.*—Facts of the description now referred to sufficiently disprove the necessary dependence of cancer upon chronic or other inflammation. But irritation is undoubtedly sometimes the immediate cause of hastening the production of the disease in individuals constitutionally prone to it; nay more, we feel disposed to admit—at least well-observed facts seem to point this way—that under

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[1] For a very remarkable instance of prevalence of the disease among both male and female members of a family, the reader may refer to Warren on Tumours, p. 281; the curious will find much speculation on the subject in M. Recamier's second volume.

[1] Nouv. Journ. de Méd. t. iv. p. 15, An. x.

[2] Of 832 patients affected with delirium tremens and observed by Rayer, Bang, Hoëgh-Guldberg, Krüger-Hansen, and others, 18 only were females. A different statement has been given in this country, but in the form of a simple assertion, respecting the relative frequency of the disease in the sexes. See Brit. & For. Med. Rev. vol. vi. p. 324. 1838.

certain conditions, at present ill understood, the disease may follow inflammation, where without the occurrence of this process, the cancerous tendency might always have remained dormant.

(*d.*) *Predisposition*[1].—Unbiassed experience fully establishes the two following positions:—first, the various presumed causes of cancer may continue in action in many individuals for a length of time with every degree of intensity and in all possible modes of combination, without producing the slightest manifestation of such disease; secondly, carcinoma exercises its most fearful ravages on subjects who have apparently never been influenced by any of its putative causes. In a word, all sound experience goes to prove that these may occasionally hasten the outburst of the morbid action or fix it in a particular spot, but never generate it. Hence we are compelled to admit the existence of individual predisposition, as a necessary condition for the production of the disease. The statistical results we have laid before the reader render the necessity of this admission more obvious than it had even previously appeared. In what the predisposition physically consists is a question to which the present state of knowledge does not permit a satisfactory answer. Some authors of repute are disposed to consider it is established by a particular constitution of the blood: the important facts bearing on humoral pathology recently elicited by ingenious experiment and observation give this view a certain degree of plausibility; but for the present it is merely hypothetical[2].

Attempts have been made to show that the predisposition may be limited to a single system; and in proof it is affirmed, that in person thus locally predisposed, an injury which in other parts of the frame would produce no appreciable effect, will, in the weak system, be followed by cancerous formation. An illustration of the opinion (in which we cannot coincide) is found in the conversion of a blistered surface into a cancerous sore in individuals with carcinoma of the skin: but a similar occurrence has been noted, when no cutaneous disease pre-existed.

(E.) DURATION.—The duration of cancerous affections varies from a few weeks to a considerable number of years: nay more; tumours, proved to be of this kind by post-mortem examination, and even ulcerated cancers, have been occasionally observed, the existence of which had not apparently shortened the lives of the individuals having them, nor hardly produced more inconvenience than a perpetual issue. The mean duration of the disease, when following the more ordinary course, has never yet been methodically investigated on a large scale.

The extreme scarcity of cases reported with accurate dates will, we trust, be sufficient excuse for the small number of those from which the following results are deduced: they are offered merely as approximations. The length of the disease is of course reckoned from the occurrence of the first symptoms or signs; cases in which it lasted so much as thirty or forty years, in the manner just referred to, are purposely omitted from the calculation: in some of those included in it the patient's existence was evidently cut short by operation—a circumstance to be allowed for in the general result.

	No. of Cases.	Duration in months.
All Species	37	27·14
Scirrhus	18	39·28
Colloid	1	24·00
Encephaloid	18	15·17

The progress of the disease is generally slower in old than in youthful subjects, and it is undoubtedly influenced by locality, though to what precise degree we have not been able to ascertain. Some other observations on this subject will be found in Part II.

(F.) FREQUENCY.—The deaths from cancer in England and Wales during a period of six months amounted to 1228; from this the subjoined results, which we have, for the sake of comparison, placed beside the quantities representing the frequency of phthisis, may be calculated.

	From Cancer. (two and a half years.)	From Phthisis. (two years.)
Proportion of deaths in every 1000 deaths.	·671	196·563
Proportion of deaths in every 1000 living.	·174	3·963
Absolute number constantly ill, supposing the diseases mortal and of the mean duration above stated.	6,140	111,416

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[1] The terms *predisposition*, *diathesis*, and *cachexia*, are used in various ways by different writers: in order to obviate misapprehension it may be well to state here the sense in which they are employed in this article. For the meaning of predisposition we refer to the text; by diathesis we understand the state of constitution in which multiplication of cancers occurs in the economy; by cachexia, the sum of general symptoms attending the disease.

[2] M. Bouillaud ridicules the idea of predisposition, because its nature is not understood, and because it is only known to exist by its presumed effects. But this is precisely the case with caloric, electricity, &c.; we know nothing of their nature, and recognise them only by their effects: will M. Bouillaud therefore deny the existence of some power or agency, call it what he will, producing the results ascribed to them?

The mortality attributed to cancer in the registers is in all probability below the true mark; of 163 deaths entered under the head of disease of the genital organs, especially of the womb, a large proportion was in all likelihood caused by carcinoma; the same is true, though to a less degree, of fatal cases of organic disease of the intestinal canal and of "stricture of the rectum and œsophagus" in persons of advanced age.

Whether the frequency of cancerous disease is on the increase is a question of considerable interest, but one to which we cannot unfortunately furnish any very satisfactory reply, as we have not the means of ascertaining the proportion of the population annually cut off by the disease during a series of years. The only statistical facts we can find bearing on this question are given in the following table showing the ratio of cancerous deaths to the total mortality of the metropolis during the last century.

Time.	Proportion of Deaths from Cancer in every 1000 deaths.
From 1728-57 (30 years)	2·0
—— 1771-80 (10 years)	3·4
—— 1831-35 (5 years)	4·4[1]
—— June 31, 1837 to Dec 31, 1838[2] (18 months)	6·1

From this it would, on first view, appear that the frequency of the disease has been steadily increasing during the last 100 years; but the real causes of the augmented ratio are more likely to be the decrease of mortality from epidemic diseases, and the greater accuracy of diagnosis, as respects carcinomatous affections. We must wait for correct answers to questions of this high import, until the present Registration Act has been in operation for a series of years.

The influence of *season* on the mortality of carcinoma is displayed in the following table, drawn up from 285 deaths occurring in the metropolis in 1838.

Quarters ending	M.	F.	Totals.
March 30	18	73	91
June 30	8	40	48
Sept. 31	11	64	75
Dec. 31	14	57	71

Hence inclemency of the weather accelerates the death of individuals labouring under carcinoma, as it does in the case of most chronic diseases. This fact is more clearly seen, when the deaths occurring in the two more genial quarters of the year are compared with those which took place in the more inclement.

	M.	F.	Totals.
Temperate half year.	19	104	123
Cold half year.	32	130	162

(G.) Symptoms.—Were it ascertained that the development of cancer is preceded by a certain number of local or general symptoms, an important step would be made towards its early diagnosis, and hence possibly towards diminishing its fatality. Probably, too, such symptoms do arise; at least it is hardly possible to conceive that so important a change as the formation of carcinomatous matter can occur in the organism without being preceded by some species of local or general derangement. However, whether they really do exist, and of what nature they may be, whether of uniform or variable character and occurrence, remains to be decided by future observation; the vague and random statements of authors on the subject are unentitled to confidence.

(*a.*) *Local.*—As carcinoma is a new formation added to the part in which it is developed, it necessarily follows as a general truth, that increase of bulk is produced by its presence to any considerable amount; in other words, it gives rise to *tumour*. The existence of such tumour is among the most important signs of carcinoma, when coupled with certain properties.

Understood in the widest acceptation of the term, tumour is consequently, from the very nature of the disease, never absent: even in cases of scirrhus of the cervix uteri, where the infiltration of a small quantity of the morbid matter may constitute the whole of the disease, an increase of bulk is produced in the affected part. Again in hollow organs, such as the rectum and œsophagus, where the cancerous matter is commonly infiltrated in the walls of the tube, the term tumour is fairly applicable. The apparent absence of swelling, sometimes met with in mammary carcinoma for instance[1], arises, as we have already explained, from the atrophous condition to which the texture of the organ itself is reduced; diligent examination in such cases rarely fails to detect the morbid substance in the form of a superadded tumour, or of a mass of the organ increased in size from infiltration. The enlargement may be perceptible as soon as formed, but rarely attracts attention until it has acquired the dimensions of a small hazel-nut. We remember, however, to have some years since examined a minute globular induration of the size of a pea embedded in the superficial layers of the mamma of a female, which attaining the bulk of a walnut in the course of a year was then removed and found to consist of scirrhus: similar facts are noticed in a subsequent page. The shape of the tumour is subject to much variety; it may be pedunculated or polypiform, wedge-like, circular with flattening, globular, or amorphous, and may or may not be circumscribed. The surface is in the outset usually smooth and even, but very generally becomes lobulated or botryoidal as the growth of the mass advances. We have already spoken of the difference of size under ordinary circumstances of the three species of cancerous tumours. The consistence of scirrhus is usually very considerable; carcinoma of this species, as observed more particularly in the mamma, sometimes possesses the dense, heavy, and unyielding hardness of stony matter. The characters of encephaloid tissue are in this respect peculiar, when it has accumulated extensively, or, in some cases, even from its earliest appearance. Combined with a moderate degree of softness is a sort of doughiness and elasticity; this character coexisting with hardness and density in other parts of the growth will leave no doubt as to the nature of the formation presenting it. It has, however, been mistaken for the fluctuation of an abscess, an error productive of most serious errors in treatment: a bistoury has more than once been plunged under this false impression into the midst of softened encephaloid masses, given rise to tremendous hæmorrhage, led to the immediate establishment of ulceration, and materially shortened the patient's life. Mistakes of this kind, excusable before Hey and Mr. Wardrop had given their graphic descriptions of the disease, and before the nature and diagnosis of "fungi of the dura mater" had been so thoroughly elucidated as they have been by the German surgeons, would at the present day be hardly venial. The sensation felt on pressing the softer parts resembles very strongly that produced by an erectile tumour. Dupuytren states that pressure gives rise in some portions of the growth to a sound like that of crumpling parchment. Scirrhus, when softened partially, becomes the seat of pseudo-fluctuation, which is, however, very different from the elastic feel of encephaloid; and a knot of varicose veins lying on the surface of a tumour may, as M. Recamier remarks, be mistaken by an inattentive person for the phenomenon under consideration.

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[1] These three proportional numbers are taken from a table calculated by Mr. Farr, and given at p. 577 of his "Vital Statistics."

[2] The absolute number of deaths from cancer registered in the metropolis during this period was 470.

[1] M. Recamier relates a case in which a diseased breast, although containing a growth four inches in diameter, was smaller than its healthy fellow.

The vascular character of encephaloid seems to render it an *à priori* probability that under favourable circumstances *pulsation* might be detected in it. The existence of pulsation is in fact one of the signs of meningeal encephaloid growths protruding through the cranium; but observers are not agreed as to whether this is a motion transmitted from the subjacent brain or arising in the substance of the tumour itself. The same indecision exists with respect to the beating noticed by Dr. W. Stokes[1] in a case of intra-thoracic carcinoma. On the other hand Dupuytren makes no question of the occurrence of interstitial pulsation, and describes the phenomenon as at first deep-seated, becoming gradually more superficial and distinct, isochronous with the pulse, unattended with rustling sound (*bruissement*) accompanied sometimes in advanced cases with general expansion of the mass, ceasing when the chief artery leading to the part is compressed, and produced by simultaneous dilatation of all the minute arteries of the tumour.

Scirrhous formations are not in their early stage endowed with any marked *sensibility;* as a general rule it may, indeed, be affirmed that they are then insensible, pressure and various manipulations exciting no discomfort. It has, however, been remarked by numerous observers that pain is very commonly experienced about half an hour after these tumours have been examined, especially if they have been at all roughly handled. When pain is excited immediately after or during pressure, this may, according to some writers, be taken as evidence that inflammatory action is going forward: if this statement be understood to apply to the tissue surrounding the cancerous substance, it is very probably correct. Subcutaneous encephaloid growths are more liable to be painful under pressure: colloid, it is said, less so than these.

The *shape of organs and parts* in which cancer is developed is greatly altered in some cases. The accumulation of the foreign matter in the liver occasionally enlarges that organ prodigiously, and modifies its figure. Cancerous deposition in the bones is sometimes attended with an extraordinary expansion of their substance. But the most important alteration of shape in a practical point of view exhibits itself in hollow organs or canals. The accumulation of cancerous matter in the walls of these parts has the effect of diminishing their caliber, whence arise the most distressing symptoms of the disease in such situations. Thus in cancer of the rectum, œsophagus, and larynx, obstructed movement of the matters naturally circulating through those ducts—of the fæces, ingesta, and air—is an early consequence of their decreasing diameter. Further, in the effort to remove the accumulation of the contents of the part which occurs above the obstruction, the muscular coat of the diseased tube becomes hypertrophous, while dilatation proportional to the quantity of the stagnating matters is likewise produced.

Among the symptoms properly so called, *pain* claims our first attention. We have here to repeat the observation made respecting the tenderness of these growths under pressure—pain rarely exists in the incipient stages. The time of its first appearance is not regulated by any fixed rule, nor is it by any means exceedingly uncommon, embracing in this proposition all species of cancer and all organs and parts internal as well as external, for the disease to originate, advance, and terminate by the death of the patient without giving rise to appreciable pain. This is an important point, for we have known the carcinomatous nature of tumours resolutely contested on the score of their being unattended with local suffering—tumours of which the ulterior progress placed their cancerous nature beyond all doubt. In other cases pain appears to exist from the earliest period of the disease ; a third class of subjects tortured with it in the outset of the complaint are released therefrom towards the close.

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[1] On Dis. of the Chest, p. 379.

The character of the pain in external cancer, more especially in scirrhus of the breast, which has commonly served as a type for all general descriptions of the disease, is usually lancinating. It is compared by the sufferer to the prodding of knives, incision with lancets, &c.[1] But like the existence of pain, the constancy of this particular character has been much exaggerated ; in a multitude of instances, even in the mamma, the pain never assumes this form ; in others it does so only temporarily, and in certain organs lancinating pain has rarely, if ever, been observed. Besides, growths of innocent nature are sometimes accompanied in the most distinct and well defined manner with suffering of this kind. How common is it nevertheless to hear the " benignant " or " malignant " character of a tumour confidently predicated from the absence or presence of this most equivocal sign. In some instances the pain is of a burning kind, and this may alternate with the former description ; in others a dull aching sensation is all that is experienced ; some patients complain of distressing pruritus ; a feeling of weight and coldness in the part constitutes the sole local discomfort of others.

Of whatever kind the local suffering is, it is rarely continuous. It is said to be most severely felt at night, wherein it shares a property of almost every description of pain. Jäger affirms that it is increased by dampness of the weather, and by an electric state of the atmosphere. The species of cancer modifies its constancy and severity : colloid is productive of comparatively little suffering ; encephaloid probably of less than scirrhus.

Mr. Travers conceives the pain to be produced by "inflammatory action" and "ulceration ;" Bégin that the commencement of softening and the invasion of pain are coeval : the general truth of both propositions (which possibly mean the same thing) may be questioned in respect of external carcinoma ; and they are decidedly erroneous if applied to that of internal organs. It may be affirmed that the intensity and constancy of the pain usually give a fair measure of the degree of rapidity with which the disease advances ; M. Recamier, however, states that he has known extremely painful cancer last 18 years, while in other cases the affection, though unattended with notable suffering, terminated fatally in a very few months ; in the former instances there was no fever, in the latter occasional febrile paroxysms.

Hæmorrhage, which does not ordinarily occur before ulceration has set in, is sometimes one of the earliest effects of the disease. Thus the discharge of a few drops of blood from the nipple in scirrhus of the breast, a tolerably frequent occurrence, has in some rare instances been the first morbid phenomenon observed. Profuse menorrhagia in not a few cases precedes all other symptoms of uterine cancer ; and in a case of pharyngeal carcinoma which we observed some years past, the patient persisted in affirming that severe hæmorrhage from the throat was the first circumstance that drew his attention to the part. In a similar manner hæmoptysis is frequently the first occurrence announcing tuberculous disorganization of the lungs. But we would not be understood to mean that effusion of blood is really the very first abnormal effect of the heterologous formation ; others have probably led the way, but from their trivial character escaped the attention of individuals who are not in the habit of carefully watching the variations of their health : admitting this to be the fact, the practical value of hæmorrhage as a symptom is by no means lessened.

Derangements of function form an important item in the symptomatology of carcinoma, and of course vary with the organ in which, or in the immediate vicinity of which, the morbid matter is developed. They may be included under the heads of irritative and mechanical. As illustrations of the former we may adduce the vaginal discharge produced by non-ulcerated scirrhus of the uterus ; the occurrence of hydrothorax and pleuritis in subjects affected with mammary cancer. In exemplification of the latter may be mentioned the occurrence of amaurosis from pressure on the optic nerve ; the interruption to vision occasioned by tumours driving the eye from its normal site ; obstinate constipation from pressure of enlarged pelvic glands ; derangement of local circulation and serous accumulation either in the shut cavities or in the cellular membrane, produced by partial closure of adjacent circulating tubes, arterial, venous, or lymphatic.

Such are the more prominent symptoms of growths which have not undergone ulceration. This process is preceded by changes in their own anatomical state, in their degree of connexion with surrounding parts, and in the appearance of the investing skin. These have already been sufficiently described, as well as the characters of the ulcer; the fact of a sanies of fetid odour and peculiarly acrid qualities being more or less abundantly thrown out by the disorganized surface has also been dwelt upon at length. The contact of this matter with the cutaneous surface may produce irritation, erythema, and even corrosive ulceration of the parts surrounding the ulcer.

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[1] *Eclairs de douleur* was the forcible expression once used by a patient in describing her feelings to Dupuytren ; a northern Professor likens these rapid pangs to " gleams of the Aurora Borealis."

The pain usually increases considerably in violence at this stage of the disease; its character is subject however to vary, as in the earlier periods. The ulcerated surface is frequently quite indolent to the touch. Hæmorrhage now becomes of more constant occurrence, originating in the manner already explained.

(*b*.) *General.*—While the local changes advance in the diseased formation, the constitution almost invariably suffers in a marked and peculiar manner. Heterologous growths possess the property of disturbing, each after its special mode, the phenomena of circulation, nutrition, and innervation, and of producing thereby a depraved condition of the organism, designated by the general term *cachexia*. The group of symptoms constituting the cancerous variety of this condition, when combined in their most marked and characteristic form, may be stated as follows: it is not intended in this enumeration to display the order of their occurrence; as this varies, we may almost say, infinitely, we have thought it better to group them according to the functional system affected.

The circulation is hurried, there are occasional fits of shivering, alternating with heat of surface, perspiration or sweatings, especially by night; the pulse, unless when the patient has been debilitated by the frequent recurrence of hæmorrhage, has a wiry somewhat resisting character; the fever gradually assumes the hectic type; the night is passed in a state of distressing watchfulness, or total insomnia; the solid portion of the blood gradually loses its healthy proportion, and passive serous effusions into the pleuræ, peritoneum, or general cellular membrane follow[1]: in cases attended with repeated and severe hæmorrhage the arteries become the seat of some modification of the *bruits de soufflet* or *de diable*, as we have had occasion more especially to observe in uterine cancer.

The patient loses his appetite, takes a complete disgust for food of every kind; the small quantity he swallows is imperfectly digested, nausea or actual vomiting frequently occurs; there is persistent thirst and constipation, alternating with colliquative diarrhœa; towards the close an aphthous eruption occasionally appears in the mouth, as is observed in other lingering chronic diseases attended with marked debility.

The nutritive functions become impaired, the tissues grow soft and flaccid, the patient loses flesh, the fatty tissues are completely absorbed, the very skin seems to undergo attenuation, the emaciation proceeding to perfect marasmus, unless when œdema of the cellular membrane interferes with its visible progress. The skin, and even the mucous membranes, assume a peculiar straw-coloured and waxy appearance, accompanied with a semi-transparent puffiness—one of the most characteristic marks of this form of cachexia, though not actually peculiar to it.

Debility and exhaustion become extreme, and occasionally make such rapid progress as of themselves to threaten the existence of the patient. The countenance maintains an habitual expression of care and suffering, the features are contracted, the temper morose, and the sufferer at length sinks—this is said to be most frequent in cases of cancer of the stomach—into a state of actual despair.

The quantity of circulating fluids gradually decreases, and the patient, unless cut off by some intercurrent malady, worn out with pain, debility, and fever, dies in a state resembling a prolonged fainting fit. Death is also frequently the result of some local irritation; in old subjects of latent pneumonia. In other cases, as when the alimentary canal is obstructed, the fatal termination is the direct effect of inanition; and certain peculiar modes of death will be alluded to in Part II. The intellectual faculties lose their clearness towards the close, but there is no actual cerebral affection, unless when the contents of the cranium become the seat of the morbid deposition.

To this catalogue of evils may be added, as of not very uncommon occurrence, a morbid change of the bones, exhibiting itself in some one of the following forms: 1. atrophy of the spongy and compact structures from defective nutrition; 2. excess of inorganic matter in their composition; 3. defective supply of saline materials, in consequence of which, the bony tissue appears as if it had been macerated in a mineral acid (carnification); 4. carcinoma of their substance. The first of these forms is singularly rare; Recamier, however, appears to have met with an example of it: of the third we have not met with an authentic instance, and insert it rather hesitatingly. In the first three cases, the morbid state is a manifestation of the *cachexia;* in the fourth, an evidence of the *diathesis* having reached the bones. In the first, second, and fourth cases, especially the last, fractures occur with extraordinary facility. In cases of cancerous deposition in the bones, the fracture may either arise from complete transformation of a portion of the cylinder into cancerous matter, or from the pressure of a central growth, causing the absorption of the compact tissue. (See Fig. 162,

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[1] As regards the condition of the kidneys and urine in cases of such effusion, the investigations of M. Rayer show that there is frequently neither co-existing renal lesion nor albuminuria; he alludes to two cases wherein chronic albuminous nephritis (Bright's disease) "occurred in the course of cancerous disease of the stomach" (Maladies des Reins, t. ii. p. 348, 1840.), but there is no evidence given to prove that the former was an effect of the latter. M. Martin Solon (De l'Albuminurie, p. 168. 1838) relates a doubtful case of the same kind.

p. 658.) When the fracture is of the former description, crepitation will either be wholly absent or ill marked; in the latter case this sign is producible in the ordinary way. When a cancerous patient suffers persistently, or pretty constantly, from pain in a particular spot in the course of a bone, the occurrence of such fracture is to be apprehended; but such local pain is not a constant forerunner of the accident, nor necessarily followed by it. The pain has been mistaken by patients for rheumatism; and this error has not unfrequently been shared by the medical attendant[1]. In not a few cases the occurrence of fracture has manifestly hastened the fatal issue of the disease.

Certain writers have described loss of the faculty of smell, imperfect vision, and other morbid conditions of the senses, as characteristic of this form of cachexia: more correct observation has disproved their assertions.

In the preceding sketch we have endeavoured to describe the most common type of cancerous cachexia; but perfect uniformity is not to be looked for here more than in any other combination of pathological actions. Thus, fever may be altogether wanting, or instead of wearing the hectic character, manifest itself simply in acceleration of the pulse and heat of skin after paroxysms of pain of more than ordinary severity. In rare instances, the frequency of the pulse diminishes with the advancement of the disease. A symptom which, in some subjects, acquires such intensity as to divert their attention from the local affection altogether, is pain, either of a fixed or erratic kind, in one or more distant parts of the frame: this usually exists in the course of the more important nerves of the extremities. M. Andral remarks, that in cases of cancer in the brain, the trunk and extremities sometimes become the seat of sensations, simulating nervous or rheumatic pains; in other instances the skin is exceedingly sensitive, in others deprived of all sensibility. The occurrence of similar suffering, in subjects dying from mammary or uterine cancer, may have sometimes depended on implication of the brain in the disease. Again, emaciation is not of constant occurrence; and even the peculiar straw-coloured tinge of the skin may not exist. The appetite too may be preserved. But enough of these exceptional conditions,—numerous other varieties of which may be found noted in published cases.

It may in general terms be stated that the cachectic symptoms do not make their appearance until an advanced stage of the disease; so general was the belief at one period in the uniform truth of this position, that the prognosis and treatment were in a great measure guided by the absence or presence and degree of intensity of the cachexia. Here was, however, a grave practical error; for as the experience of accurate observers has proved; 1. cancerous growths may, in their earliest stage, even before induration of the lymphatic glands has taken place, produce such general functional derangement as is indicative of the most severe form of cachexia[1]; 2. cases in which the whole anterior surface of one side of the chest, or the vagina and the major portion of the uterus were destroyed by cancerous ulcerations, have been known to be accompanied with comparatively slight general disturbance (Breschet); 3. patients have occasionally to the last preserved their appetite and flesh, and been able to attend with more or less closeness to their ordinary business (Bayle); in other words, the disease has terminated fatally without the establishment of cachectic symptoms.

If we consult the works of writers who have touched upon the question, we shall find that they, almost without exception, no matter to what school they belong, regard a modified state of the blood as the cause of the cachectic symptoms. While some, however, advance the opinion as an hypothesis based on many probabilities, others announce it as an ascertained fact: among the latter is M. Cruveilhier. This pathologist, considering the cancerous cachexia and diathesis as one and the same thing, explains the occurrence of both on the principle of venous transmission:—hence the existence of either involves that of the other[2]. In this confusion of diathesis and cachexia the Parisian pathologist is joined by Müller. Yet that the distinction between the two is not a scholastic refinement, but actually exists in nature, is rendered clear even by the examination of the present question. In fact, no regular relation subsists between the intensity of the cachexia and the number of organs secondarily affected; cancer of the uterus, which habitually gives rise to most intense general reaction, rarely induces, as has been stated, extensive secondary formation; nor is it exceedingly uncommon to find numerous organs affected in subjects who have suffered to a slight amount only from cachectic symptoms. The necessary inference from these facts seems to be that the diathesis and the cachexia are produced in different modes; and as we have seen that strong probabilities argue in favour of the production of the former by cancerous impregnation of the venous blood, we cannot do otherwise than reject the agency of this in respect of the cachexia. Yet it must be confessed, that until an extended investigation into the condition of the blood at all periods and under all circumstances of the disease shall have been undertaken, these questions are destined to remain undecided.

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[1] Salter, in Med. Chir. Trans. vol. xv. p. 186. S. Cooper, in idem, vol. xvii. p. 51.

[1] This fact shows the fallacy of an hypothesis of Velpeau, that the cachexia only occurs in cases of softening of internal or ulceration of external carcinoma.

[2] M. Cruveilhier in one part of his work (Livrais. xxv. Rectum, p. 3.) states his belief that the cancerous cachexia depends less on the disease itself than on the hæmorrhages with which it is accompanied;—a curious notion from a pathologist professing the general doctrine of the disease, explained in a previous page, for it is almost tantamount to saying that an effect is increased by the removal of its cause. Independently of this, however, it is incorrect, for the cachexia sometimes exists where hæmorrhage has never occurred.

This class of symptoms appears often to be modified by the species of cancer. According to Laennec fever is absent during the greater part of the course of encephaloid, and in many cases death occurs without any perceptible acceleration of the pulse having ever been noticed. When fever does exist, it appears rather to depend on accidental circumstances than on the mere presence of the morbid tissue. Emaciation does not ordinarily come on till the disease has existed for a considerable time, but once set in, rapidly advances to marasmus. Velpeau's case, already frequently adverted to, proves that the disease may occupy a vast number of organs and exist for a number of years (six at least) without producing notable loss of flesh or discoloration of the skin. In other instances, on the contrary, a limited accumulation in a single organ excites the most formidable train of general symptoms. Colloid, as Cruveilhier states, is the species of cancer accompanied with the least marked and most tardily developed signs of constitutional suffering; and in the majority of cases of cancer of the stomach without local symptoms, observed by him, the disease was of this kind. Pockels met with a case of gastric colloid in which none of the usual evidences of cancerous disorganization existed, except the straw-coloured tint of the skin. (Müller.) In respect of the influence of organs on the cachexia, the mamma, uterus, and stomach are unquestionably the most commonly attended with its intensest forms. Andral affirms[1] "that cancer of the stomach produces the greatest degree of emaciation; that females whose cervix uteri has been totally destroyed by cancer, retain their natural looks to the last." the latter clause of this statement assuredly refers to exceptional cases.

(H.) Diagnosis.—The diagnosis of cancerous growths of external parts previously to the occurrence of ulceration, sometimes presents considerable difficulty. They may by possibility be confounded with all tumours which produce no change in the colour of the skin or temperature of the surface, and in which distinct fluctuation of a liquid is not perceptible. (Bégin.) The subject of diagnosis will, however, be considered under the head of each organ, and it is therefore unnecessary to multiply general remarks in this part of our article. The characters of the ulcer which we have described at length, its everted and ragged edges, its indurated base, the peculiar fetor of the discharge, the tendency to fungating growth, the frequent occurrence of hæmorrhage, form a group of phenomena which combined can scarcely mislead. But in secondary syphilitic cases the most experienced surgeon sometimes feels doubt as to the nature of the affection, a doubt which is not in all cases cleared up by the history of the patient's previous life. Even simple ulcerations of the tongue from the irritation of a carious tooth will occasionally closely resemble cancerous destruction, and be hardly distinguishable therefrom until the removal of the irritating body, followed by rapid cicatrization, proves the innocent nature of the sore.

(I.) Prognosis.—As regards the ultimate termination of the disease, the question of prognosis is involved in that of curability, which will be presently considered. With respect to its mean duration, our application in particular cases of the general result already given must be materially modified by the species of cancer, the organ affected, the stage of the local process, the activity of the growth, the amount and constancy of pain endured, and above all perhaps by the condition of the general health, the degree to which the nutritive and other functions are affected by the presence of the morbid mass. As a general truth, cancerous tumours which have apparently commenced to form subsequently to the receipt of a local injury are more susceptible of being delayed in their progress by treatment, than those in the evolution of which no such influence is traceable.

§ 4.—*Therapeia.*

Before entering on the subject of treatment, it seems natural to say a few words on a point which has been the theme of warm controversy—the curability of the disease.

A disease is capable of cure either by a natural process or by art. The former may be generally referred to the heads of resolution, and of altered nutrition; the one exemplified in the disappearance of inflammatory changes, the other in the conversion of tuberculous matter into an innocuous, cretaceous, or calcareous concretion. Now one of the most essential attributes of cancerous substance is an unswerving tendency to grow; its nature is opposed to resolution. Yet there would be temerity in denying the possibility of the latter occurrence. Mr. Travers relates that "the solution of chloride of lime effected the absorption of a large tumour (in the course of some months) regarded by competent authorities as scirrhus, in a lady whose other breast had been extirpated for that disease. Not long after she died of asthma from diseased lungs; the scirrhous tubercle appearing not only in the chest but in several of the abdominal viscera." We cannot regard the connexion of this resolution and the use of the chloride otherwise than as a mere coincidence: perhaps, as in Recamier's case, there was here only metastasis and not disappearance of the morbid matter. Researches in comparative pathology appear to have shown that cancerous masses may become the seat of an altered form of nutrition leading to a change in their composition tantamount to a cure. M. Trousseau has frequently traced the conversion of scirrhus into ossiform matter in the lower animals; and in the horse, dog, and cat, satisfied himself of the transmutation of encephaloid and scirrhus into encysted masses containing a homogeneous matter finely granular, varying in colour from a straw-coloured yellow to a rusty red, without vessels, cellular filaments, or the least vital connexion with the inner surface of the cyst. The separation of the "dead matter" from the tissues of the body by a lining cyst protects the latter from the irritative effects which the former might produce. We have already given our reasons for dissenting from the statement of authors respecting the bony transformation in the human subject: the second kind of change is not alleged to have been observed in man; there is, nevertheless, no *à priori* reason why it should not occur.

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[1] Additions à l'Auscult. Médiate, p. 260. Par. 1836.

In some rare instances spontaneous gangrene of the surrounding parts has led to the separation and expulsion of cancerous growths and been followed by complete recovery[1]. Cline[2], Everard Home, Steidele, and others, have observed this fortunate accident. Dupuytren considered it most likely to occur in cases of encysted cancer: we are unaware whether this notion is confirmed by general experience. The separation of cancer in this way is not however certainly followed by recovery: Cruveilhier alludes to a case in which healthy cicatrization set in after the fall of the growth, yet indurated masses soon made their appearance in the cicatrix, and though these were destroyed with the chloride of zinc, the disease spread to the axilla.

It is also affirmed that the cicatrization of true cancerous ulcers has occasionally proceeded to completion, and a permanent cure resulted. Of this extraordinary occurrence an example is related by Nicod[3]; Bayle declares that he has seen several such cases. Such are the more important facts bearing on the spontaneous cure of cancer.

Upon the incurability of the disease by merely medicinal means almost all writers are agreed; but in respect of the possibility of eradicating it from the system by operation there is no such unanimity. While some maintain that successful extirpation has seldom or never been witnessed: others proclaim their successes as almost equal in number to their operations. The elder Munro states, that of sixty persons operated on for cancer four only remained free from relapse at the end of two years; Scarpa in the course of a long practice observed only three cases of extirpation of true scirrhus permanently successful; Boyer maintained that of 100 patients operated on 95 or 96 succumb under a return of the disease. These calculations, as M. Littré remarks, refer chiefly to cancer of the breast and testicle, and would be of a more favourable kind if extended to cancers of all parts and developed at all ages. True cancer has been radically cured after a second, nay even a third operation. Lacombe[1] relates with full detail the history of a woman aged 49, who had been operated on four times for cancer of the mamma, and had, at the time the work was published, enjoyed perfect health for five years. In the year 1770 the general result of operations performed by Mr. Hill of Chester stood thus: of 88 cancers, extirpated at least two years before—not cured, two; broke out afresh, nine; threatened with a relapse, one; in all twelve, which is less than a seventh part of the whole number. At that time there were about forty patients alive and sound, whose cancers had been extirpated above two years before." Reviewing the clashing results of Munro and Hill, Richter exclaims, "Jure sane dixeris de uno eodemque morbo hos viros loqui, dubitari fere potest." The experience of the best surgeons permits us to go further than this, and affirm as an indubitable fact that they did not write of the same disease—that many of Hill's cases must have been examples of simple mammary hypertrophy, of fibrous tumours, and other non-carcinomatous conditions. In the quaint language of Dionis—"Pour chanter victoire il ne faut pas avoir pris une glande engorgée pour un cancer caractérisé, comme font quelquefois ceux qui se vantent d'en avoir guéri des milliers[2]." Even local relapse is no absolute proof of the cancerous nature of an extirpated tumour; reproduction of other structures is not very unfrequently entailed by a portion of the mass being left behind. But if there be delusion in the extravagant estimates of Hill and one or two other such exceptional operators, there is still more serious error in the dictum of those surgeons who, like Boyer, having witnessed a considerable number of unsuccessful operations, generalize these results and shut their eyes to every fact of opposite tendency. Obliged to admit that affections declared cancerous before operation have been cured thereby, they reject the evidence of such cases on the plea that the complaint could not have been cancerous, *because it was cured*: in other words, they beg the question at issue.

We would warn the student against the notions promulgated by some writers on this subject, originating in *à priori* theories on the nature of the disease: against the doctrine of M. Bouillaud, for example, who sees no difficulty in the way of curing cancer, because cancer is merely an inflammatory induration; against that of M. Breschet, who, guided by the speculations of Bichat, traces the disease to an aberration of "organic sensibility," and is persuaded we may readily manage this peccant entity.

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[1] Garnéri, Bull. de la Soc. Méd. d'Emulat. Déc. 1810. Sept. 1811. Dupuytren, Journ. Hebdom. t. iv. p. 38, 1829. Richerand. Nosogr. Chirurg. t. i. p. 381. Ed. 2.

[2] Lancet, vol. ii. p. 401.

[3] Bull. cit. No. 1. 1810.

[1] Propositions sur le Cancer, 1805.

[2] Cours d'Opérations, p. 640.

The following propositions appear to embrace such facts as are established respecting the curability of carcinoma by art. 1. There is no existing evidence to show that carcinoma of an internal organ has ever been cured. 2. Cancer has never been removed by medicinal agents alone. 3. Morbid productions possessing the anatomical and pathological character of scirrhus have been removed with the knife, and no return of the disease been observed for a number of years, and occasionally during the entire course of a life prolonged beyond the expectation of life in healthy individuals at the period of removal. 4. Although it cannot be doubted that many of the tumours referred to by M. Recamier were not really composed of that tissue, yet it seems impossible to affirm this of all of them: it would follow then that carcinoma has in rare instances been cured by compression, aided by other external and internal remedies. 5. The probabilities of effecting a cure vary with the species of cancer. There are few authentic instances on record of permanent recovery after the ablation of encephaloid [1]; successful removal of scirrhus is of more frequent occurrence, and the tendency of colloid to reproduction, although Velpeau states it to be extreme, is probably lower than of the other varieties. 6. The earlier the morbid mass is removed the stronger are the chances of ultimate recovery: Scarpa's three successful operations were performed within the first three months; of twenty-seven schirri removed by Flajani within the first month of their formation two only returned[2]. 7. Encysted cancer, provided the cyst be removed, is less liable to return than non-encysted. 8. The chances of success diminish out of all proportion with each repetition of the operation. 9. It has been stated that the removal of cancer in some parts is more prone to be attended with relapse than in others: mammary cancer is instanced as an example of the former, osseous of the latter. We are disposed to acquiesce in this notion, but it requires to be proved numerically; and the fact that under the term osteo-sarcoma have been included growths in bone of almost every description, fibrous, cartilaginous, &c., as well as the truly cancerous, renders it exceedingly probable, if not certain, that the supposed immunity of bone in this respect, has been exaggerated. 10. It is indubitable that local, and probably distant, reproduction frequently depends on some of the diseased growth being left behind: some microscopical observations illustrating this point may be seen at p. 650. The inference is, that were ablation perfect, recoveries would be more common.

It would in theory appear that the removal of a tumour cannot in itself cure the disease, as the local formation is but a symptom of a general vice of the economy; but this only proves that the local removal acts, however inexplicable this may be, as a sort of alterative on the constitution, or that a change co-arises spontaneously in the general state of the system. This may be rendered clearer by an illustration. Phthisis, a disease of which the constitutional nature is not disputed, is well ascertained to have disappeared symptomatically after the expulsion of tuberculous matter, and contraction of cavities, or after the conversion of that matter into inorganic salts. Again, all surgeons are acquainted with the regeneration, as it were, of the individual, which sometimes follows the removal of a joint affected with the same tuberculous or scrofulous disease.

Prophylaxis. — The idea of a prophylactic treatment involves the possibility of recognising the tendency to the disease before the actual formation of carcinomatous matter. In the present state of the science this, as has been stated already, cannot be done; nevertheless M. Littré considers it possible that in some cases, when a suspicious state of health exists in persons springing from a cancerous father or mother, the development of the disease might be warded off by a change of climate, of habit, of diet, by the use of mineral waters, &c. The same precautions might advantageously be enforced in the case of the immediate relatives of persons decidedly cancerous. And, further, as certain morbid formations are prone to become cancerous from the development of scirrhus, encephaloid, or colloid in their substance, the removal of the former may be looked on as prophylactic against the latter.

Internal remedies.—Among substances presumed to act on the disease by altering the condition of the blood, *conium* has obtained vast celebrity. Originally recommended by Störck in 1761 as an infallible remedy, it is still confided in by some practitioners. Störck employed the extract, and commencing by grain doses increased the quantity to two drachms daily—in fact, until it produced a slight degree of toxic effect. The extraordinary exaggeration of Störck was soon made notorious by the inquiries of various experimentalists throughout Europe; yet M. Recamier has of late years affirmed that several cases of internal and external cancer have yielded in his hands under the use of this drug. He limits the patient at the same time to one-third of the ordinary quantity of food, and directs the use of the decoction of sarsaparilla after each dose of the medicine and as a substitute for water at meals. M. Recamier administers the extract, and ascribes his success in some measure to the following mode of preparing it: the plant is exposed to the vapours of vinegar or alcohol before expression; and the juice heated in a sand bath and evaporated to the ordinary consistence. Dr. Copland has prescribed the inspissated juice and powdered leaves in cases of internal scirrhus in combination with the alkalies and tonics, and has always found them much more beneficial when thus associated; the amount of benefit is not, however, stated. The conclusion drawn by Bayle from an impartial review of the statements of others and from his own experience is, that conium never cures cancerous disease, but occasionally retards its progress and alleviates pain. The general sense of the profession at the present day, spite of M. Recamier's pleadings, is decidedly in favour of M. Bayle's conclusion. M.M. Marjolin and Pauly are of opinion that its only action consists in destroying the digestive powers and producing headache.

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[1] Mr. Travers has never known a patient survive longer than four years after the removal of encephaloid. Scarpa lays it down as a law that ablation of this growth invariably hastens death. We shall have occasion to refer to cases distinctly disproving the general truth of the Italian's doctrine; and Gräfe "has *often* extirpated fungus hæmatodes without any relapse having occurred for 16, 18, or 20 years." Gaz. Méd. de Paris, p. 170. Mars, 1835.

[2] But were these all examples of true scirrhus? Vid. Collezione di Osserv. e Riflessioni, t. i. p. 277.

Aconitum, belladonna, hyoscyamus, laurus cerasus, stramonium possess similar claims to notice, but in a less degree.

Since its first recommendation in the tenth or eleventh century by a monk named Theodoric, *arsenious acid* has been extensively prescribed for carcinoma; opinions as to its efficacy are divided. On the one hand appear the assertions of an experienced Swedish practitioner, Roennow, who after fifty years' employment of it had succeeded in curing thirty cases of well-marked cancer: on the other, experiments on an extensive scale, conducted in Germany, France, and in this country, teach us to question its power in curing any form of the disease. Mr. Hill, however, states as the result of his experience, that this substance retards the progress of the complaint, and often prevents scirrhus from passing into the ulcerative stage[1]. Dr. Copland believes that when this medicine is cautiously employed, both internally and externally, in conjunction with narcotics and alkalies, or otherwise judiciously combined, Mr. Hill's opinion in its favour is not much too highly coloured.

Considerable hopes were excited some years since regarding the efficacy of *iodine;* but the fallacy of these hopes is now matter of notoriety. Dr. Copland, however, still recommends iodine in small and repeated doses with potassa and conium or opium. He states that in two cases of "reputed scirrhus" which had withstood other means of cure for a long time, perfect recovery was obtained through a course of the hydriodate of potass: the statement is, however, qualified by an admission which is exceedingly likely to be well founded, that they were not examples of true carcinoma.

The *iodurets of iron and of arsenic,* but more especially the latter salt, have been forcibly eulogised by Dr. A. T. Thompson. The evidence in their favour is such as is supplied by the following case. "A lady, ætat. 46, had a tumour in each breast, accompanied with occasional severe darting pains; on one side the tumour was moveable, on the other fixed; the arms had become œdematous, the complexion was sallow and anxious, there was constant fever and the health was rapidly sinking. . . . Ten or twelve leeches were applied at short intervals with poultices composed of poppy heads, digitalis and conium, and the ioduret of arsenic administered in one-eighth of a grain doses, with extract of conium every eight hours; the dose of extract was gradually augmented from nine to sixty grains in the day. Three grains of iodide of iron in solution were taken between each dose of the pills; the patient was strictly confined to a milk diet. This plan of treatment was pursued for upwards of eleven months, during which time the iodide of arsenic was carried up to doses of one-third of a grain. . . . the tumours gradually became softer and disappeared, the pains ceased, and the general health improved in a striking manner, until the patient was completely freed from disease[1]." The number of times leeches were applied is not stated, and the treatment was altogether of too composite a character to allow of our forming a precise estimate of the value of the iodide of arsenic. We should, nevertheless, be strongly disposed to give this salt a trial under favourable circumstances.

Preparations of *iron,* originally recommended by Justamond and De Marre, have of late years been reintroduced to the notice of the profession by Mr. Carmichael. This eminent practitioner prefers the subphospate, but also exhibits the phosphate and bi-phosphate, carbonate, and tartrate internally. The external use of these salts is combined with the internal; if the disease be in the ulcerated stage they are applied in the form of a paste made with water; if not, a lotion, consisting of a strong solution of some one of them, is kept constantly applied to the part. The ammoniuret of iron received the especial recommendation of Denman[2].

With respect to the use of *mercurial preparations,* Mr. Burns remarks that no fact is more clearly ascertained than that mercury always exasperates the disease, especially after ulceration. Of the truth oft his statement, if applied to large doses of the mineral, especially when exhibited with a view to affecting the gums, no doubt can be entertained. Sir A. Cooper, however, employs it as an alterative in the form of Plummer's pills. Strange to say, in France, where calomel is so sparingly employed, the exhibition of this salt in combination with conium has been strongly recommended by M. M. Gama and Bégin. These practitioners commencing by very minute doses gradually increase the quantity until salivation, or a state of continued purgation is established. There are few medicines, according to M. Bégin, which more frequently realize the hopes of the practitioner. General and local antiphlogistic treatment with emollient or narcotic local applications, and, if practicable, compression, are enforced at the same time.

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[1] Ed. Med. Surg. Journ. vol. vi. p. 58.

[1] Lancet, Oct. 27, 1838, and *Crane*, Lancet, Aug. 31, 1839.

[2] Observations on the cure of Cancer, p. 77.

Animal charcoal in doses of half a grain, by degrees increased to four grains, twice daily, has been spoken highly of by Weise[1]. His favourable announcements have not been confirmed.

Electricity and galvanism have been tried in consequence of an account published by Dr. Easton respecting a lady who having been struck with lightning found herself gradually freed from a scirrhous tumour which had resisted a variety of modes of treatment. Experiments were made with these agents by Brisbane and Walther among others, but not with results justifying any confidence in their efficacy.

External remedies.—The idea of diminishing the size of cancerous growths by repeated leeching is of very early date. Valsalva energetically lauded this method of treatment, and Fearon, persuaded of the inflammatory nature of the disease, trusted to it almost wholly; venesection being substituted when an internal organ suffered. Modern experience has established the degree of utility of local abstraction of blood. In the earliest stages of diseased induration the application of leeches is strongly advisable ; even as a guide to the diagnosis of tumours of doubtful character it is useful. The progress of growths of undoubtedly carcinomatous nature may be thus retarded, and incidental inflammatory symptoms in the adjoining tissues successfully combated ; but beyond this, capillary depletion has no power. The number of leeches applied must be regulated by the size of the tumour ; it should vary between twelve and six ; a smaller number causes an afflux of fluids to the part without emptying the vessels sufficiently. When the tumour is adherent to the skin there is danger in continuing this practice, as the bites have frequently been known to pass into persistent ulcerations. M. Bégin, whose confidence in the powers of local depletion would be more encouraging were it not for his belief in the inflammatory nature of the disease, applies leeches even to ulcerated surfaces.

As an effectual method of lowering the nutrition of cancerous parts, the *ligature of the arteries*, or rather chief artery, leading to them, was advised by Maunoir[2]. Applied by this practitioner more especially to sarcocele, it had, at an earlier period (Lucas in 1814), been made trial of in this country in cancer of other parts, but not with very encouraging results[3]. It is manifest, in truth, that unless in situations receiving their blood from a single source, the anastomatic supplies must soon undo what has been done by the operation. Yet Dupuytren, believing that erectile tissue always exists in smaller or larger proportion in encephaloid tumours, practised ligature of the principal artery, when he conceived the cancerous matter had a very small share in the composition of the foreign growth. M. Magendie[1] states that he tied the carotid with the effect of permanently stopping the growth of an enormous scirrho-encephaloid tumour on the side of the head and face, which had twice been reproduced after partial ablation. M. Jobert has recently modified this method, adding to the ligature of the principal vessels that of the nervous filaments connected with the cancer. He has thus cured, he informs us, four ulcerated cancers of the lips, and one of the tongue[2].

Methodic *compression* of carcinomatous tumours, introduced and declared to be singularly efficacious by Young, subsequently rejected by the profession, from the unfavourable estimate formed of it at the Middlesex Hospital[3], has of late years been experimented on a very large scale by M. Recamier. The more important part of his results is as follows : " Of one hundred patients, sixteen appeared to be incurable, and underwent only a palliative treatment : thirty were completely cured by compression alone, and twenty-one derived considerable benefit from it : fifteen were radically cured by extirpation alone, or chiefly by extirpation and pressure combined, and six by compression and cauterisation : in the twelve remaining cases the disease resisted all the means employed." The compression should at first be exceedingly gentle, and have the effect simply of supporting the tumour in close apposition with the subjacent parts. In proportion as the morbid mass becomes habituated to its action, the pressure is increased and gradually rendered exceedingly powerful. The greater the tendency to irritation in the growth itself, and in the surrounding tissues, the more important is it to attend to this precaution. M. R. generally employs perfectly smooth disks of agaric, laid over each other, and retained *in situ* by a roller, as the compressing materials. M. Bégin sometimes substitutes a laminated plate of lead, modelled to the tumour, and surmounted with a pyramid of graduated compresses. This application (which is far from a novel one) frequently becomes painful, and cannot be endured. M. R. recommends a renewal of the apparatus every day, or every second day : M. Bégin thinks it better to change only when the bandages grow loose, and prefers, in consequence of this view, an elastic corset, capable of accommodating itself to the decreasing size of the part, as the compressing agent, wherever circumstances admit of its use. The treatment should be continued for a considerable time after the resolution of a tumour.

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[1] Ueber die Zurückbildung der Scirrhen und Polypen : Leipzig ; 1829.

[2] Nouv. Méthode de traiter le Sarcocèle, 1820.

[3] A. Cooper, Essays, part i. p. 184 ; 1818.

[1] Phén. Physiques de la Vie, t. i. p. 119.

[2] Brit. & For. Med. Rev. vol. ix. p. 260 ; 1840.

[3] C. Bell, Surg. Obs. vol. i. p. 4 ; 1816.

The conditions interfering with the success of this plan are, according to M. R., excessive magnitude of the morbid growth; the existence of cavities in its interior; the conversion of the tissue of the diseased organ itself into carcinoma; a state of softening, ulceration, or fungous vegetation; the extension of the disease beyond the reach of direct compression; obstinate local neuralgic pains, and great fulness of person.

It can hardly be contended, as we have already stated, that some of the growths thus benefited or cured, were not really scirrhous; and the testimony of Mr. Travers[1] is favourable to this mode of treatment. Nevertheless the best proof of the general inefficacy of the plan is, that at Paris, where we should naturally look for the greatest number of converts, scarcely a single hospital surgeon now resorts to this mode of treating scirrhous tumours. We only remember to have seen it tried once, in the course of two years, by M. Roux, and in this instance he made the trial at the importunate solicitation of the patient. Mr. S. Cooper has recently used compression in one case at University College Hospital,—it seemed only to hasten the establishment of ulceration. There is an easy source of error in the absorption of the surrounding natural tissues, which is undoubtedly produced. Perhaps the strongest objection to the general application of the plan is that, by buoying up the hopes of patients, it induces them to decline the operation till too advanced a period of the disease.

That the external use of *iodine*, in the form of ointment, sometimes completely removes tumours, possessing the characters of scirrhus, where it has been had recourse to at an early stage of their development, is a fact of which we have witnessed some examples. The truly cancerous nature of such growths may of course be questioned; yet a trial of iodine externally, provided the part be indolent, and its use excite no irritative action in the tumour, is certainly advisable: the length of the trial should be regulated by the apparent influence produced on the tumour. An excellent ointment is composed of five grains of iodine, and a drachm of the ioduret of potassium, to an ounce of prepared lard. The ioduret of lead is sometimes well borne, where the former combination proves irritating.

Mercurial ointment and plaisters, and even repeated *dry friction* of the tumour, have had their advocates; but such means are not at the present day employed[2].

Caustics of various kinds have, from the earliest times, been employed for the destruction of ulcerated cancer. The *actual cautery* was probably, according to Bayle, the first agent used for the purpose[1]. The French surgeons still occasionally employ it, especially for the removal of fungating excrescences, and sometimes, as an additional security, burn the wound after the removal of a cancerous mass. In our own country there is a just repugnance to the actual cautery, and it has fallen completely into disuse[2].

Caustic potass, the *bichloride of mercury*[3], the *chloride of antimony*, and the *nitrate of silver*, are among the caustic substances which have enjoyed more or less reputation for their effects on cancerous ulcers. The *acid nitrate of mercury*, made by dissolving one part of proto-nitrate of mercury in eight of nitric acid, is a favourite escharotic in the French hospitals; and is especially lauded by Recamier as possessing a marked affinity for the diseased tissue, and as producing healthy granulations, even on a cancerous basis. *Arsenious acid* has long formed the chief agent in numerous preparations, both empiric and professional, for the destruction of cancer. In the article Arsenic, the composition of some of these preparations, among others that recommended by Dupuytren, is stated.

Within the last few years the *chloride of zinc* has been introduced to the notice of practitioners as an escharotic by M. Cancoin, and experimented on in this country with very favourable results by Mr. A. Ure[4]. From the relation given by the latter gentleman, it appears to produce a rapid and salutary change on the characters of corroding ulcers, and in at least one instance, to have successfully enucleated a large non-ulcerated scirrhous tumour of the mamma. In the latter instance there has, Mr. Ure informs us, been no relapse. In two cases of cancerous ulceration of the face, where the disease, though of long standing, was superficial, it acted most favourably in the hands of Mr. Lawrence, and the cures have been permanent[5]. The preparation employed by Mr. Ure is a combination of one part of the chloride to two of sulphate of lime: M. Cancoin mixes the salt with various proportions of flour. The thickness of the layer of paste must be proportional to the depth of eschar required to be produced. Its immediate effect, according to Mr. Lawrence, is that of a powerful stimulant, causing great vascular excitement, with swelling, bright redness, and severe pain, the last continuing twenty-four or forty-eight hours, or even longer.

The *chloride of gold* appears to have produced marvellous effects in the hands of M. Recamier A woman affected with fungating cancer of the cervix uteri, which had already destroyed almost the entire of that portion of the organ, underwent seven or eight applications of this caustic : the local and general symptoms yielded completely ; the ulceration ceased ; the body of the organ, which had been engorged, lost its unnatural size ; the lancinating pain and hæmorrhages were no longer complained of. This caustic is prepared by mixing nitrochloric acid (aqua regia) with pure chloride of gold, in the proportion of one ounce of the acid to six grains of the salt[1]. Notwithstanding all this M. Recamier has, it would seem, given up this chloride for that of platina[2].

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[1] Loc. cit. vol. xvii. p. 306.

[2] Suckling toads was a popular remedy about half a century ago in our own country in cases of mammary cancer, at least, if we may judge from one of the private letters of Junius to Woodfall, who, alluding to the Princess-Dowager of Wales, at that time afflicted with a cancer, that destroyed her in 1772, mentions that "she suckles toads from morning till night."—*Mason Good.*

[1] Hippocr. Epid. lib. vii.

[2] A curious mode of applying heat to these surfaces was devised by Le Comte. It consisted in cauterising with the rays of the sun, collected by a powerful lens: this eccentric process is said to have been attended with success in one case of cancer of the lower lip.—(*Mém. de la Soc. Roy. de Méd.* 1776.)

[3] See a paper, by M. Ordinaire, on the treatment of ulcers of various kinds with corrosive sublimate, in Gaz. Médicale, Novr. 1839.

[4] Med. Gaz. 1836, vol. xviii. p. 287.

[5] Crosse, in Trans. of Prov. Assoc. vol. v. p. 61.

As a general principle, these agents should be applied in such manner as to produce the requisite effect, if possible, by a single application, otherwise the irritation produced, gives new activity to the disease. In superficial cancerous ulcers of the skin, in cases where carcinomatous matter appears in the cicatrix after operation, or where some suspicious tissue has been accidentally left behind, and the patient refuses to submit to further use of the knife, they may be safely and advantageously used. But in cases of glandular cancer they are wholly inapplicable as a general truth : the agony they cause is infinitely greater than that produced by the knife, and there can be no certainty that every particle of the diseased formation is removed. Fatal results have occurred from the absorption of arsenic, and in the article on uterine cancer, the serious accidents to which other species of caustics have given rise, are noticed. Many of these objections do not apply to the chloride of zinc.

Kreasote has been made favourable mention of by Gräfe[3]. A case of extensive cancer of the face and arch of the palate is stated by this observer to have been remarkably improved in condition by the application of this substance. It may be applied either pure or diluted with water ; it does not produce much pain[4].

The inoculation of the matter of *common and of hospital gangrene* has been practised, with the design of imitating the natural process of cure before referred to[5].

Various preparations of *lead* have been from time to time extolled as specifics for scirrhus. Goulard affirmed that he had cured ulcerated cancer with them ; Brambilla extols the virtues of a plaster composed of minium, olive oil, and turnip juice ; Gesner[6] ascribes singular virtue to the acetate made into a liniment with turpentine. The calmer judgment of Bayle has limited the real value of these preparations to their sedative action : as exercising this action in a marked manner, he recommends a combination of six drachms of "litharge of gold," six drachms of vinegar, and two ounces of olive oil, to be spread in a thin layer on the ulcerated surface.

Counter-irritation, in the form of blisters, issues, or setons, has occasionally appeared to produce beneficial effects ; but such result is not to be always looked for, and there may be positive mischief in its employment. M. Cruveilhier[1] refers to a case in which a blistered surface became cancerous, a circumstance already adverted to.

In the strictly *palliative treatment* the two main indications are to relieve pain and remove fetor. Almost all the dressings for cancerous sores have been devised with a view to the fulfilment of one or other of these indications. Some surgeons give the preference to hemlock poultices made of the recent plant as a sedative application ; bruised carrots, also, ease pain and correct fetor. The latter vegetable was first brought into notice by Sultzer in 1766, and, *more solito*, announced as possessing the power of radically curing the disease. Boiled figs and vegetable charcoal have been used with similar views ; some practitioners simply cover the part with compresses steeped in laudanum ; fomentations of stramonium leaves are mentioned by Mr. Warren. Decoction of cinchona with tincture of myrrh is found a serviceable application where the surface is flabby and disposed to bleed. In the course of a protracted disease like cancer it will of course be found necessary to change the species of dressings. Their temperature may be regulated by the patient's feelings ; but much warmth is said to stimulate the growth of the disease.

The chlorurets of lime or soda are useful in removing fetor, and are said to produce a good effect occasionally on the surface of the ulcer. Dr. F. Churchill of Dublin has recently recommended injections of a solution of nitrate of silver with the same view in cancer of the uterus ; they likewise diminish, it is said, the irritability of the ulcer and lessen pain.

Hæmorrhage is occasionally productive of temporary alleviation of pain, and when moderate in quantity and of rare occurrence is therefore rather favourable than otherwise. Under other circumstances it is of course necessary to stop it, which is often a task of much difficulty. When depending on capillary effusion, pressure is the most likely means of arresting it ; when from the perforation of an artery, ligature of the vessel is indicated. This should be practised outside the morbid growth. Mr. Travers was in one instance obliged to tie the carotid to stop the bleeding from an encephaloid tumour at the angle of the jaw.

In the *general treatment* of subjects labouring under cancer, our object, according to Dr. Copland, must be "to support the energies of life by exciting the digestive functions and the abdominal secretions and excretions, and to impart vigour to the frame by suitable diet and regimen." For these purposes he recommends tonic infusions with liquor ammoniæ acetatis or with the alkaline carbonates and conium or hyoscyamus; bichloride of mercury in the compound tincture of cinchona or compound decoction of sarsaparilla; or small doses of blue pill or hydrargyrum cum cretâ with camphor and some one of the narcotic extracts; the phosphates of iron combined with conium, or the sulphates of quinine and zinc. The condition of the bowels must be carefully watched and due alvine action obtained by mild aperients, or laxative enemata. The internal use of opium and its preparations, especially of the salts of morphia (the bimeconate would appear to possess some particular claims to notice in this disease) must be had recourse to for the relief of pain: but the longer the exhibition of anodynes can be postponed the better. The ill effects of opium on the stomach and bowels have led to a trial of the salts of morphia by the endermic method, and, as it is alleged, with excellent results. The cuticle should not, of course, be removed for the purpose in the immediate vicinity of the disease.

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[1] Rev. Méd. 1835, t. ii. p. 380.

[2] Pauly, Mal. de l'Utérus, p. 345.

[3] In seinem und Walther's Journ. b. xx. s. 151.

[4] See also Marchal, Gaz. Méd. de Paris, p. 107; 1835.

[5] See Cruveilhier, Essai sur l'An. Path. t. i. p. 128.

[6] Beobachtungen, b. v. s. 141.

[1] Livrais. xxvii. Mammelles, p. 4.

The *diet* of cancerous patients should be regulated by their capabilities of digestion; the mere cramming of food into a stomach incapable of aiding in its assimilation is as positively deleterious, as the system of starvation enforced by the practitioners of the Broussaisian school. The advantages of rigid abstinence have, it is true, been enforced on purely practical grounds: Pouteau flattered himself he had radically cured several patients by limiting their nourishment to five or six pints of iced water daily for a period of about two months; Pearson and Lambe in this country and Hufeland in Germany were also advocates for extreme restriction in diet. At the present day starvation is frequently enforced as an adjunct to the local antiphlogistic treatment; but though patients are by these means rapidly reduced to a state of marasmus, their cancers flourish as before. Such treatment promotes the rapid occurrence of debility and sinking, which unfit the organism wholly for combating with the destructive influence of the disease. Suffice it to say that experienced practitioners in this country are agreed as to the appropriateness of a light, easily digestible, succulent diet, where no special circumstance exists to contraindicate it. Stimulants of all kinds are decidedly injurious. The hygeienic condition of the patient generally should be carefully attended to, cheerfulness of mind promoted as far as possible, and participation in private and public amusements, so long as circumstances admit of this, enjoined. Whether change of climate possess any influence on the progress of carcinoma is an unsettled point. Unless at the very outset of the disease, and more particularly as a prophylactic measure, little is, we fear, to be hoped from it. It might be coupled with the use of mineral waters; those of Karlsbad, Marienbad, Ems, &c. are recommended by the German authors[1]. In a small number of cases referred to by writers, where the patients removed at an advanced stage of the disease from a cold to a warm latitude or *vice versâ*, no apparent amelioration resulted from the change: "*cœlum non* morbum *mutant qui trans mare currunt.*" But no fair inference can be drawn from such cases.

Ablation.—On the importance of having early recourse to ablation, we have already insisted; it remains for us to consider the circumstances which in particular cases contra-indicate the operation, and some other points connected with it.

Prudent surgeons will not advise removal of carcinoma,—1, when such adhesions or local extensions of the primary disease exist, as would render it impossible to remove the mass completely either by excision or by amputation of a limb; 2, when the disease is manifestly spreading or in a state of active growth; 3, when the existence of internal carcinoma is even probable; 4, when the cancerous cachexia is thoroughly established; 5, when the disease has existed for a number of years in an almost stationary condition; gives rise to no serious derangement of health, and is rather an inconvenience than a malady. To these prohibitory conditions should be added, in the majority of cases, enlargement and induration of the lymphatic glands in communication with the diseased part; such condition, however, does not amount to an absolute contra-indication of the operation, though it diminishes materially the chances of success; the change in these bodies may be simply irritative, and disappear after the removal of the primary disease, and they have, when really cancerous, been successfully excised. Desault, Amussat, Lisfranc, and others appear to think enlargement of the glands hardly any hinderance to ablation, when recent[2]. Extreme debility, provided it depend on pain and repeated hæmorrhage, and do not coexist with the cachexia, though diminishing the probability of success, does not absolutely ensure failure: it rests with the surgeon to balance the dangers of the operation against the degree of strength and vital energy of the patient, and act accordingly. The same consideration is applicable in cases of very advanced age, and where the manual part of the operation or its immediate consequences are attended with serious risk to life. The presence of even extensive ulceration did not, in several cases on record, prevent a fortunate issue to the operation; but with respect to the cachexia, few practical surgeons will deny the general truth of the proposition above laid down, although in a few instances which may be found scattered through works from the time of Morgagni[3] downwards, ablation has been followed by disappearance of the general state thus designated. In some of these cases, too, the symptoms may have been really those of a *false cachexia*, a subject excellently handled by M. Recamier.

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[1] The particular water to be recommended, will of course vary in different cases.

[2] Gaz. Méd. de Paris, 1835, p. 143.

[3] Ep. 50. Art. 16.

Admitting that we have a case to deal with in which no formal contra-indication to the performance of the operation exists, the time when it ought to be undertaken remains to be determined. In general terms, we should say the moment the cancerous nature of the disease is established : provision is thus made for a moderate trial of such means as are known to exercise evident influence on indurations simulating carcinoma. The habit of temporizing has more than any other cause brought operations for cancer into discredit ; and in cases of encephaloid disease the necessity for prompt action cannot be too strongly enforced, nor should our being obliged to amputate a limb to remove the morbid growth prevent us from urging the patient to submit, before it is too late. It may be objected that, acting on this principle, non-cancerous diseases of a comparatively innocuous character have been erroneously removed, — that simply hypertrophous mammæ have been cut out as affected with scirrhus. We admit the fact, but to us it seems infinitely better to run the chance of uselessly removing, in very rare instances, an organ of the sort, than of leaving a true scirrhus to destroy the patient.

So far we have spoken of the operation as a means of radical cure ; but it may perhaps become allowable as a palliative,—as likely to prolong life and conduce to a comparative *euthanasia*, in certain cases, where the agony endured and the abundance of the hæmorrhage are rapidly wearing out the existence of the sufferer. This is the more true, as in some cases which, had they been permitted to run their own course, must, to all appearance, have terminated fatally in a few weeks, an operation executed under these most disheartening circumstances has added several months, nay some years, to life. These, however, are occurrences of extreme rarity ; and unless the patient be determined to submit to the knife with a full consciousness of the comparatively slight benefit he is entitled to expect from his submission, the operation should not be had recourse to : the surgeon may *yield* to the entreaty of the patient, but cannot conscientiously *advise* removal.

The extirpation of cancer has been effected with caustics, by ligature or with the knife. Enucleation of non-ulcerated carcinoma with arsenical preparations is no longer undertaken by educated practitioners ; but, as we have mentioned, the chloride of zinc has been successfully used for this purpose of late years by Mr. Ure. It was formerly much the habit to remove these growths by ligature when attached by a narrow base, and Recamier is of opinion that carcinomatous vegetations are less prone to return when thus removed than when cut away. Where there is reason to dread obstinate hæmorrhage, as in the instance of circumscribed tumours in the rectum, this mode of operating has its advocates. These are, however, exceptional cases ; in all others the knife is to be preferred, and is in the majority the only possible means of removing the entire disease. Some practitioners recommend the repeated application of leeches before the operation, for the purpose of removing an inflammatory action in the vicinity of the tumour and of diminishing its own size : compression is by others advised with the same view. These practices, admitting that they have the desired effect, seem very likely to induce a false estimate of the extent to which the elementary molecules of the cancer may extend, and hence of causing some of the morbid matter to be left behind. Sir A. Cooper strongly advises an alterative course of Plummer's pill before operation ; this idea of the utility of a constitutional treatment seems to have been entertained at a very early period, as the following passage shows : " Galenus autem sectionis tantum chirurgiam admittens, in hunc modum tradit. Si quando cancrum manuum et scalpelli opera curare *ausus fueris, vacuationem ab atræ bilis purgatione auspiceris*[1]."

In the performance of the operation the most important point to be borne in mind is the absolute necessity of removing every particle of diseased matter ; and in order to ensure this result, a stratum of healthy tissue should if possible be removed along with the morbid growth : for this purpose it may be necessary to extirpate an organ or amputate a limb. It is decidedly advantageous that the wound should be united by first intention, but the surgeon should not run the risk of retaining implicated skin to effect this object. When extensive excision of skin is required, the resulting hiatus may be closed up by a plastic operation.

Efforts have been made to devise a means of modifying the constitution after operation so as to avert reproduction. With this view, exhibition of alterative medicines, occasional small blood-letting, the establishment of issues, &c. have been recommended, but such modes of treatment have not been distinctly productive of the desired effect : M. Rayer, however, " has fancied " that relapses are less frequent after removal of cutaneous cancer, when an issue has been previously made in either extremity[2]. M. Recamier recommends pressure, but if the tendency to relapse be strong, we fear little is to be hoped from the practice. Change of climate is now, if under any circumstances, likely to be beneficial.

A few years since M. Martinet published some cases in which the return of the disease after ablation was alleged to have been prevented by the aid of plastic surgery. Having attempted to restore by rhinoplasty the portion of a nose which had undergone cancerous ulceration, and given origin to fungous excrescences in spite of excision, the actual cautery and arsenical paste, he was astonished at the rapidity and permanence of cicatrization. In three other cases he performed an analogous operation and with similar success. Although here we have not a sufficiently extended experience to prove the general value of the plan, yet the results obtained certainly merit attention. Three of the patients were seen three and six years after the operation in perfect health; the fourth died two years and a half after its performance of an affection unconnected with her cancer: yet that these were instances in which the disease was likely to prove fatal in the ordinary course of things appears from its previous progress in each, especially from the fact, that in three of them there had already been relapse after operation, in two recurring even twice. M. Martinet's process consists in "applying a sound, well-nourished flap of skin, taken from a more or less distant part, on the wound resulting from the excision of a cancer, either immediately after the operation or after the development of granulations:" in his own cases he proceeded in the latter manner[1]. The account given by the French surgeon does not appear to have encouraged others to similar attempts; at least Zeis and Blandin, the most voluminous writers on Plastic Surgery, do not allude to their having been made[2].

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[1] P. Ægineta, vi. 45, p. 463. Ed. Basil.

[2] Dis. of Skin, translat. by Willis, p. 270.

Before closing this section of our article we shall briefly advert to a few general questions of importance. Among these is the degree of relationship of the three species of carcinoma. The differences of these products may first be exhibited tabularly.

ENCEPHALOID	SCIRRHUS	COLLOID
Resembles lobulated cerebral matter.	Resembles rind of bacon traversed by cellulo-fibrous septa.	Has the appearance of particles of jelly inlaid in a regular alveolar bed.
Is commonly opaque from its earliest formation.	Has a semi-transparent glossiness.	The contained matter is strikingly transparent.
Is of dead white colour.	Has a clear whitish or bluish yellow tint.	Greenish yellow is its predominant hue.
Contains a multitude of minute vessels.	Is comparatively ill supplied with vessels.	(Its vessels have not been sufficiently examined as yet.)
Is less hard and dense than scirrhus.	Is exceedingly firm and dense.	The jellylike *matter* is exceedingly soft; a colloid *mass* is, however, firm and resisting.
Is frequently found in the veins issuing from the diseased mass.	Has not been distinctly detected in this situation.	The pultaceous variety has been detected in the veins.
The predominant microscopical elements are globules, not always distinctly cellular, and caudate corpuscula.	The main microscopical constituents are juxtaposed nuclear cells; caudate corpuscula do not exist in it.	Is composed of cells in a state of *emboîtement*.
Occasionally attains an enormous bulk.	Rarely acquires larger dimensions than an orange.	Observes a mean in this respect.
Has been observed in almost every tissue of the body.	Its seat, as ascertained by observation, is somewhat more limited.	Has so far only been seen in a limited number of parts.
Very commonly coexists in several parts or organs of the same subject.	Is not unusually solitary.	Has rarely been met with in more than one organ.
Is remarkable for its occasional vast rapidity of growth.	Ordinarily grows slowly.	Grows with a medium degree of rapidity.
Is frequently the seat of interstitial hæmorrhage and deposition of black or bistre-coloured matter.	Is comparatively rarely the seat of these changes.	
When softened into a pulp appears as a dead white or pink opaque matter of creamy consistence.	Resembles when softened a yellowish brown semi-transparent gelatinous matter.	Undergoes no visible change of the kind.
Subcutaneous tumours are slow to contract adhesions with the skin.	Scirrhus thus situated usually becomes adherent.	
Ulcerated encephaloid is frequently the seat of hæmorrhage, followed by rapid fungous development.	Scirrhous ulcers much less frequently give rise to hæmorrhage, and fungous growths (provided they retain the scirrhous character) are now more slowly and less abundantly developed.	
The progress of the disease after ulceration is commonly very rapid.	There is not such a remarkable change in the rate of progress of the disease after ulceration has set in.	
Is the most common form under which secondary cancer exhibits itself.		
Is the species of cancer most frequently observed in young subjects.	Is much less common before puberty.	Has so far been observed in adults only.

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[1] Gaz. Méd. de Paris, No. 42, 1834.

[2] Plastic operations have frequently been performed after the removal of cancer of the face, with a view to remedy deformity, and with results in respect of permanent cure, which invite attention to M. Martinet's opinions. Vid. Zeis. Handb. der Plast. Chirurg. s. 367, and Blandin, De l'Autoplastie, p. 256.

The number and variety of these distinctive characters seem to require the separation of these adventitious products as distinct species; while they are insufficient to counterbalance the weighty reasons for uniting them into a genus afforded by their fundamental similarity. So true is the latter statement, that some eminent pathologists, as has already been intimated, regard these formations as one and the same primarily, founding their opinion more especially on the following facts. 1. The different species are found coexisting in different organs in the same subject. 2. They are even met with in one and the same organ in close proximity. 3. After the ablation of a cancerous tumour, the reproduced growth frequently belongs to a different species from the original: thus encephaloid follows scirrhus; scirrhus more rarely encephaloid (Müller); encephaloid appears in distant parts after the removal of colloid[1]. 4. In the hard state encephaloid and scirrhus are not to be distinguished by their physical characters. 5. Structure possessing the appearance of scirrhus may soften into true cerebriform pulp. This is little more than another way of expressing the fourth argument.

The accuracy of the first three positions is incontestable; they prove the close alliance of the formations referred to, but by no means demonstrate their identity. It must also be admitted that encephaloid, when in the state termed crude by Laennec, instead of being opaque and whitish sometimes displays a semi-transparent bluish tint, is extremely hard, and presents but little visible vascular development—characters approximating it to true scirrhus. Attempts have, however, been made by M. Trousseau and M. Rouzet to establish the distinction even under these circumstances. M. Trousseau points out that the grain of encephaloid is larger and less resisting than that of scirrhus, and that the former structure does not, as the latter, creak when divided with the scalpel: M. Rouzet observes that the surface of a section of encephaloid instead of remaining plane, as is the case with scirrhus, springs into irregular elevations, and presents a number of mamillary prominences separated by depressed interstices. These observations are, as may very readily be ascertained, well founded; but we agree with Professor Bérard in thinking, that when the characters in question appear in encephaloid, that product is perfectly distinguishable at first glance from scirrhus. Yet admitting, as is the fact, that a specimen of hard carcinoma may be shown to an anatomist without his being able to determine whether it would have ultimately presented the apple-juice-like appearance of softened scirrhus or the creamy aspect of diffluent encephaloid, it is still evidently going further than is warrantable to conclude from such inability that the distinction does not really exist. The progress of micrography has shown that certain substances, considered identical by observers misled by gross physical characters, are in reality extremely different: a single instance of this—the long subsisting confusion of softened fibrine and pus—is a sufficient illustration. Respecting the softening of scirrhus into matter of encephaloid aspect, the presumed occurrence of which, however, may in reality depend upon the inability just spoken of—we have already ventured on a hypothetical explanation, apparently less irreconcileable with facts than that for which we desire to substitute it.

The reader will determine for himself whether the particular properties of colloid justify its separation as a species. For our own parts we can entertain no doubt that, even without taking into consideration the marked peculiarity in the mode of development and growth of its microscopical elements, the position we have assigned this structure is a more just one than that given it by Otto, Recamier, and Carswell, as a variety of scirrhus, or by Dr. Hodgkin, who considers it "identical with, or bearing the closest relation to fungoid disease."

The degree of affinity of carcinoma and certain morbid formations next requires to be noticed.

The majority of writers regard *multilocular cysts* (the most usual anatomical character of the disease erroneously termed ovarian dropsy) as totally unconnected with cancer. Cruveilhier and Dr. Hodgkin do not acquiesce in the common opinion. The French observer unhesitatingly classes ovarian cysts with carcinoma, particularly with the colloid species, affirming that it differs from the ordinary form of this disease simply by the greater size of its meshes. But here is, as we believe, vicious generalization: the general appearance of encysted masses is otherwise extremely distinct from that of colloid cancer; they have neither the regularity of form or arrangement in their loculi, nor the uniformity in the contents of these, so remarkable in the latter formation. Besides, as is well known, these ovarian cysts may acquire very considerable size without affecting the economy in the slightest degree except by the mechanical hindrance to the performance of certain functions: they possess neither the power of converting the adjoining tissues into their proper substance, nor of producing a particular form of cachexia; and M. Cruveilhier would be puzzled to find a case of encysted ovary attended with the local and general symptoms of cancer unless deposition of encephaloid or scirrhus had taken place in its structure. Further, M. C. is far from consistent; for while he regards the septa of colloid as formed of the walls of dilated veins, he considers the primary loculi of encysted ovary as constituted by the vesicles of the part in a state of dilatation[1]: yet the two structures are declared to be identical. Again, we find in this author's classification of ovarian cysts a distinct class characterized by being developed on a cancerous basis: surely, if the multilocular cyst be itself a cancer, this is a most defective ground of distinction. Dr. Hodgkin on his part assuming that the multilocular ovarian cyst is the type of cancerous structure, is obliged to include the two forms of disease in the same anatomical category; he considers that there is in fact "no appreciable difference either in the structure and arrangement of the cysts of gum cancer and encysted ovary or in the composition of their contents" (p. 291). Nevertheless he formally denies the "malignant" character of the ovarian multilocular cyst. Now he elsewhere (e. g. p. 268) makes the presence of the cystiform arrangement a test of "malignity," but as the disease of the ovary in question possesses this arrangement in the most distinct manner, it follows that it is "malignant:" hence the same formation is at once "malignant" and "non-malignant." For our own parts we reject multilocular cysts from the class Cancer: where pathology is made the co-groundwork of classification with anatomy, this could not be otherwise.

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[1] Cruveilhier, Livrais. v. Testicule.

[1] This is the only fair inference from the article "Kystes" in the 5th Livraison; but in Livraison

Two opinions respecting the relation of cancer and *fibrous growths* have already been noticed (p. 597.); a third originates with Dr. Hodgkin. Presuming further on the infallibility of his test of "malignity," this observer affirms that in consequence of their "possessing the structure of compound adventitious cysts," there is inaccuracy and fallacy in applying the term "fibrous tumours" to the well known bodies developed in the parenchyma or under the serous or mucous investitures of the uterus—that these are in truth "scirrhous malignant growths[1]." This opinion, directly clashing with the experience of Meckel, Bayle, Laennec, Louis, Andral, Cruveilhier, Dupuytren, Sebastian[2], R. Lee, Carswell, &c., will be fully examined in the article Fibrous Tumours.

M. Cruveilhier, pushing to their extreme point his notions respecting the seat of carcinoma in the veins, affirms that in respect of structure, *erectile tissue* and cancer are one and the same; that after the former has been freed from blood, and the latter from the cancerous juice, they cannot be distinguished from each other. In fact, to use his own words, "cancer is a varicose tissue, the meshes of which are filled with cancerous juice; varicose or venous erectile tissue, a cancerous structure, the meshes of which are filled with blood[3]." Hence the presence of the cancerous juice constitutes their sole distinctive character: now elsewhere this author declares that the only difference between scirrhus and certain fibrous tumours is the characteristic juice of the former. The evil of bold generalization is here strikingly manifest; for it follows from these opinions, that as fibrous and erectile tumours differ from the same by the same, they are themselves identical.

Respecting *melanosis* we have already spoken; for the consideration of the subject of corroding and intractable ulcers we beg to refer to the observations on cancer of the skin and uterus.

Much contradictory matter has been written on the question whether "malignity" is inherent in and peculiar to carcinoma, or accidental and capable of being manifested under various conditions. The disputation on the subject has mainly arisen from the variety of meanings attached to the term. Uniformity of opinion cannot subsist on the point, while some designate as "malignity" the sum of the properties of cancerous tissues, others use the word as a synonym of incurability[1]; others with Dr. Hodgkin apply it to the combined characters of encysted structures, and the majority attach a vague meaning to it which they are totally unable to define: and yet grave authors of the latter class actually fractionize the unknown quantity, and write about "*semi-malignity*." As the perpetuator of much misapprehension the term should, we think, be altogether given up; if, however, it be understood as signifying the power of a morbid growth at once to assimilate different tissues to its own substance, to produce similar disease in distant parts, to reappear after destruction and give rise to a peculiar cachexia, it can be justly applied to cancer alone. If the microscopical composition of adventitious growths be urged as an argument against this statement, if it be said that different properties cannot appertain *ab origine* to growths which are identical in the nature of their elementary constituents, we can only repeat the answer already made to Müller's doctrine of homologousness: though the isolated microscopical fragments may be identical, the union of two or more of them produces, according to the plan of such union, perfectly different compounds. Even Müller himself admits that there are characters by which "malignant" may be distinguished from "benignant" growths, but they are only appreciable by the naked eye or with a lens, and lost under the microscope. In fact, *in the present state of knowledge*, chemistry and micrography would lead us into the error of confounding growths perfectly dissimilar in nature and

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xxv. (Ovaire, p. 2.) he affirms that the areolar cysts of the ovary are seated in the venous erectile rete of that organ.

[1] Guy's Reports, vol. i. p. 334.

[2] Krull, Diss. de Nat. et Caus. Tumor. Fibr. Uteri, p. 27. Groningæ, 1836.

[3] Livr. xxx. Veines, p. 3.

[1] "Malignant, by which term I mean incurable" (Travers), a notion amplified by others into the mysticism—"a malignant disease is one in which the destructive action overbalances the restorative." It will be perceived that according to Mr. Travers' definition the most innocent fibrous, cartilaginous, and lipomatous tumours, as well as the tubercles of phthisis, are all "malignant."

effects. But the question is a clinical one; are individuals destroyed with the symptoms and manifestations of cancerous disease, in whose frame neither scirrhus, encephaloid, nor colloid are to be found? Never, we confidently affirm. Cystic and erectile formations sometimes apparently produce such effects; but when this has been the case, post-mortem examination discovers them to have been the seat of carcinomatous development.

Finally, the following proposition directly flows from numerous facts stated in the preceding pages: a cancerous tumour under all circumstances, even should it remain single and stationary for years, is but the local evidence of a general vitiation of the system. But, it may be inquired, is not this a contradiction—how is it possible that if the organism at large be in a state of disease, a single spot shall alone manifest its presence? We confess our inability to explain away this difficulty; but neither the fact of its existence nor its inexplicability shake the solidity of the opinion advocated. All pathologists, who have carefully investigated the history of the tuberculous affection admit that local agencies, of whatever kind they may be, can never cause the production of a particle of tubercle—that constitutional derangement must lead the way. Now here we have precisely the same difficulty to contend with—a knot of tubercles may exist for years in the summit of a lung, and every other organ remain free to the last from the disease. Why this is so, we know not: these are the mysteries of pathology, and they are mysteries which it would, in the existing state of the science, be idle to attempt to penetrate.

From all that has been said we may deduce the following DEFINITION of cancer. Cancer is a disease anatomically characterized by the presence of scirrhus, encephaloid, or colloid, originating in a general vitiation of the economy, and possessing the properties of assimilation, of reproduction, and of destroying life by a peculiar cachexia.

PART II.—OF CANCER OF PARTICULAR PARTS.

I.—*The Skin.*

The skin, especially of some regions of the body, is exceedingly prone to phagedenic ulceration; and much uncertainty prevails among writers as to the precise relation such corroding ulcers bear to cancerous disease.

The condition of the skin preparatory to ulceration of this kind varies. 1. The most common change consists in the formation of an indurated excrescence, which exhibits on section, as was first shown by Scarpa, the characters of ordinary scirrhus. 2. The cutis is the seat of scirrhous infiltration. 3. Lesions which commence by ulceration induced by the continuous action of an irritating body, or of a particular virus (syphilis), acquire secondarily, in predisposed subjects, a basis of true scirrhus, and assume a phagedenic disposition. 4. Another class of ulcers neither originates in nor is accompanied with the formation of carcinomatous matter, but nevertheless possesses a corroding and intractable character. Now, in cases belonging to the three first categories, there is no difficulty in understanding why the ulterior progress of the disease should be that of cancerous affections: in the two first it is truly carcinomatous *ab initio*, in the third it eventually becomes so. If it were proved that those of the fourth possess the properties of such affections, that they are capable of producing special disorganization of the lymphatic glands, and contamination of the viscera, then there would be serious error in making the presence of encephaloid, scirrhus, or colloid, necessary to the existence of cancer; but this has never yet been done, and the sole cause of their having been ranged with cancerous diseases is, doubtless, their intractable, or so called, "malignant" character. Many simple syphilitic and scrofulous ulcers should, on the same plea, be pronounced cancers.

From the uncertainty referred to has arisen some difference of opinion respecting the true nature of the disease termed "chimney-sweepers' cancer." According to our views this affection may, or may not, be cancerous, and, in the latter case, may be so either primarily or secondarily; primarily, if it originate in true scirrhous infiltration or excrescence; secondarily, if the ulcer produced by simple irritation become the seat of scirrhous or encephaloid formation. Of the cancerous nature of the specimen, in which we discovered the following appearances immediately after excision, no doubt can be entertained. Four layers might be distinguished in the mass removed from the scrotum: 1. a stratum of firm laminar cellular membrane, presumed to be healthy; 2. the deep layer of the morbid structure, consisting of an indurated substance as resisting as fibro-cartilage, creaking like that tissue when the point of a scalpel was rubbed along its divided surface, and possessing a linear arrangement—the fibres being perpendicular to the base; 3. a stratum of much softer material, of yellowish white colour, lobulated, and somewhat of a fungous aspect; 4. a viscid coating of ichor, of a brownish grey tint. These layers, more closely examined, presented the following characters. 1. With a common lens, a distinct partition of the cellular layer, by white opaque septa, enclosing yellowish and more transparent matter between them, was plainly discernible. Under a microscope of 150 powers, a particle of this putative normal tissue was found to consist of cells, some irregularly shaped, others pentagonal, and containing a distinct nucleus with nuclear corpuscules. A number of minute bodies, without internal cavity (granules of Müller) floated free; in one part, an elongated mass, with exactly the appearance of the fibrous matter of carcinoma fasciculatum (see Pl. I. fig. 8), presented itself: it had the transparent character of that product[1]. 2. In the fibrous or linear part, caudate corpuscula, with or without nuclei and nuclear corpuscula, were abundantly seen, and presented the three varieties of arrangement shown in Pl. I. figs. 4, 5, 6. These were associated with cells of the description frequently referred to. 3. In this layer, a fibrillar stroma, of the kind represented in Pl. I. fig. 10, constituted a most remarkable feature. 4. In the ichor, we observed, in addition to nuclear cells, curved caudate corpuscules.

The most common seats of cutaneous cancer, as a primary disease, are the vicinity of the orifices of the mucous canals, the scalp, and the parts of generation; its characters are the same in all parts of the body.

The scirrhous excrescence or tubercle of the face may present the natural tint of the skin, or, as is more common, a reddish or dirty grayish hue, without any, or at least notable, thickening of the cuticle; and is indurated, firm, and frequently rests upon a broad basis: varicose vessels in some instances ramify over the surface. It may exist in this state for a length of time, even for years, if unirritated, without being productive of inconvenience; in other cases it is the seat of constant pruritus, or burning heat from the outset. If excited, either by being scratched, or injured in shaving, or otherwise, the progress of these excrescences becomes more active—they increase in size, or, if the summit has been laid bare, a thin fluid exudes, which forms a scab; the latter is generally torn away, or drops off, and re-forms, while the ulcerative process advances underneath. An ulcer, at first superficial, but ultimately acquiring an excavated basis and elevated edges, exhibits itself; this eventually spreads in all directions, preceded in its progress by carcinomatous induration, and constitutes one of the conditions to which the term *noli me tangere* has been applied. Large fungous formations sprout upon its surface in some cases; the discharge is abundant always, but especially so under these circumstances, and copious hæmorrhage is not very uncommon. The vast destruction of parts, combined with the partial paralysis produced by the implication of filaments of the seventh pair, disfigures and deforms the countenance in a most striking manner. Even in this advanced stage of the disease it is not exceedingly uncommon to observe a temporary amelioration in its appearance, and a partial attempt at cicatrization, with formation of small florid granulations. In some instances, after excoriation has occurred, the surface of the excrescence becomes finely mammillated, acquiring the appearance of a mulberry (*moriform cancer*), and in this state it may remain for a long period before the establishment of destructive ulceration. When the affection originates in scirrhous induration of the cutis, it may likewise remain for years without exhibiting activity, until an abrasion or fissure occurs and a crust is produced; the course of the disease is henceforth the same as in the former case. It is not very rare for successive crusts to form without the separation of the more superficial having preceded. Large hard grayish concretions are thus formed, sometimes singularly elongated, and twisted like the horn of a ram; they present transverse sulci, corresponding to the number of layers successively deposited. These horny concretions may also form on the moriform variety. The ulterior progress of these cases is the same as of the former.

The constitutional symptoms are in general obscure, until ulceration sets in; indeed, until the occurrence of this change, the health of the patient does not commonly suffer in any perceptible degree. They are, generally speaking, less marked than those arising from carcinoma of the external glandular organs.

M. Rayer confirms the statement of Scarpa respecting the scirrhous nature of the tissue of these excrescences. Incised lengthwise, and examined under a lens, says the former writer, they are seen to consist of a "lardaceous" tissue, traversed by whitish lines, and analogous in colour to fibro-cartilages. If softened to any extent, a whitish matter may be pressed out of them, and they frequently contain true encephaloid substance.—The same pathologist describes some anatomical varieties of the disease. His *melanic* variety we believe to be the ordinary cancerous tissue tinged with black colouring matter. *Leucoid* cancer is distinguished by the milky white colour of the excrescences; some of these are flat, and depressed in the centre; prominent at the edge, which is covered with vascular ramifications: others are rounded, and vascular in the centre, while their circumference is of a milky-white colour. Under the magnifier they appear to be formed of hypertrophous chorion, infiltrated with a milky fluid. Like the melanic variety, they seem to indicate a cancerous diathesis. *Molluscifom* cancer is distinguished by the flatness or slightly-rounded elevation of its tubercles in the centre; they are of the same colour as the skin; their surface is wrinkled, and in the largest tubercles, the furrows are concentric. Their component tissue is true scirrhus. M. Rayer also describes encephaloid growths of the skin, but in the example given of this form of the disease, the morbid formation appears rather to have originated in the subcutaneous cellular membrane. This species of cancerous matter, however, as has already been mentioned, is sometimes produced in cutaneous nævi and erectile formations.

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[1] This shows distinctly that the germina of cancer (for here they probably extended much beyond the part examined, which almost presented the grosser characters of the disease,) are occasionally left behind in tissue, which appears at the time of operation, to be perfectly healthy. A remark of the same kind has been made by Gluge: "it is not only," he says, "in the encephaloid tissue itself, of affected organs, that its globules are found; they are also to be discerned in parts apparently healthy; for example, in portions of encephaloid lungs, which still retain the property of crepitating." (*L'Institut*, No. 191, Jan. 4, 1837.)

Cancerous disease of the skin may be distinguished from analogous affections, before and after ulceration, by the following circumstances, as pointed out by M. Rayer. 1. The tubercles of lupus, of Greek elephantiasis, and of certain forms of syphilis, are almost always indolent; those of cancer, sooner or later become the seat of lancinating pain. Lupus exedens scarcely ever appears in persons past the prime of life; this is, on the contrary, precisely the period at which cutaneous cancer commonly originates. Phagedenic cancer commences by a single excrescence, in lupus exedens there are usually several;—in lupus non-exedens there are almost invariably a considerable number. Cancerous ulceration is often attended with considerable swelling of the soft parts, and the neighbouring vessels are dilated and varicose; these sores are besides made worse by the application of escharotics. When the nose is the part affected, the bones also suffer, and exhibit alterations characteristic of cancer; cancerous sores discharge plentifully, instead of being covered with thick dry scabs like those of lupus. The ulcers of lupus, of Greek elephantiasis, and of syphilis, do not occasion pain like those of cancer. (See Lupus.) But, as has been remarked by numerous observers, ulcers are occasionally met with which present many of the characteristics of cancerous sores, and are perhaps only distinguishable, clinically speaking, from these by the rapid recovery which sometimes follows the removal of a hitherto undiscovered cause of irritation. Common warts are characterized by the thickening of the cuticle which is almost always present, and by the cleft appearance of their surface; they never ulcerate spontaneously. Mollusciform cancer cannot well be distinguished from molluscum, unless when symptoms or other alterations of unequivocally cancerous character coexist. An interesting example of the difficulty which may arise in the diagnosis, has been published by Dr. A. T. Thompson[1].

The attempt to discuss cancerous excrescences is utterly vain. As a late testimony to the correctness of this statement, we may cite the fact, that M. Rayer applied forty leeches round one small and recent cutaneous tubercle, without producing the smallest effect on it: the patient dying, the growth was found to contain encephaloid matter.

The true remedy is ablation, and the earlier it is performed the better. After the occurrence of ulceration, so long as the sore and its scirrhous basis remain superficial, excision may be practised, and is decidedly preferable to cauterization. When the disease has destroyed the tissues widely and deeply, extirpation with the knife is impossible; and all attempts to remove it with escharotics have no other effect than to add new virulence to the process of destruction. Under these circumstances we are reduced to palliative treatment[2].

II. *Subcutaneous Cellular Tissue.*

The subcutaneous cellular tissue of the trunk and extremities is one of the most common seats of encephaloid; but is rarely, if ever, observed to give primary origin to scirrhus. What has been said respecting the mode of growth, symptoms, termination, and treatment of encephaloid tumours generally is perfectly applicable to the disease in this situation. It will therefore be only necessary here briefly to recapitulate their characters.

For practical purposes it may be well to consider the progress of the diseased formation as divisible into three stages, which correspond with physiological changes in its substance. 1. The tumour varies in size when first detected by the patient, sometimes not exceeding, at this period, that of a pea[1] or of a marble; in other instances it attains much greater bulk before it excites attention. At this stage, though firm, it possesses a certain share of elasticity; it is moveable, rather distinctly circumscribed, smooth and even on its surface, and of equal firmness in every part of its extent; the investing skin presents its natural thickness, suppleness, and elasticity; little, if any, pain is complained of; the patient is sometimes even unconscious of the existence of the foreign growth, which may also be handled firmly without exciting uneasiness. 2. After a variable time the tumour begins to increase in size in a marked manner and sometimes with extraordinary rapidity; it loses its smooth and even surface, becomes irregularly lobulated, exhibiting in some parts considerable projection almost amounting to *pointing*, accompanied with a softness which conveys a sensation resembling that of fluctuation; while in other parts this is much less marked, and elsewhere the original firmness of the growth is still preserved. The skin, still moveable on the surface of the tumour (which itself grows immoveable from spreading among the muscles and subjacent parts), becomes evidently attenuated, in some cases to such a degree as to resemble mere cuticle, while it assumes a livid or yellowish red colour, especially at the most prominent parts; the superficial veins enlarge. Severe pain, frequently of the lancinating kind, is commonly felt at this period, and the part is often exceedingly tender to the touch. Sometimes increase of temperature is observed on the surface, but this is to be taken as evidence probably of a sub-inflammatory state of the integuments. 3. The skin at length gives way at one or more prominent points, a thin serous fluid with more or less blood exudes from the openings, and fungous masses spring from these within a brief period—it may be a few hours—after perforation; the destruction of the skin advances, and the phenomena which have led to the invention of the term fungus hæmatodes proceed in the manner already described.

It is important to remember that pain may be the first symptom; the patient is sometimes led to seek advice for this, before the least swelling is to be detected, in a situation where an encephaloid growth afterwards advances with rapidity[1]. The discovery of the tumour may or may not have been preceded by an impaired state of the general health.

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[1] Lancet, Oct. 27, 1838, p. 177.

[2] Rayer, Diseases of the Skin, translated by Willis Lond. 1835.

[1] Wardrop, Travers, &c.

The characters of encephaloid growths during the two latter stages are marked and peculiar; during the third an error of diagnosis is with ordinary attention impossible; during the second, unless some peculiar circumstances combine to mislead the observer, it is difficult to mistake the nature of the tumour; during the first—and the characters attributed to this may exist for some time after the new formation has acquired considerable bulk—no small difficulty is sometimes experienced in deciding on its nature: if it give rise to no constitutional suffering this difficulty may be insurmountable, until the ulterior progress of the affection shall have been watched; a fact which proves the necessity of caution in the prognosis of incipient tumours. The nature of the tumour being ascertained, its limits and original seat require to be made out. Careful examination both of the growth itself and of the adjoining vessels and nerves is essential for this purpose; the commemorative symptoms, also, will throw light on its original site, and the latter in turn clear up the question of its existing relations. If the disease originate under a fascia there is more than ordinary density and resistance. Encephaloid cancer, springing from the substance of the bones of a limb, "begins in general enlargement of the limb in the part opposite to the seat of the complaint and to a considerable extent around it:" if in the subperiosteal cellular membrane "the general swelling of the limb is less, and the particular tumour more prominent" than when it has a truly osseous origin[2]. But to pursue this subject further would be to encroach on the article Tumour.

If the growth be situated in such manner as to admit of being completely excised along with a thick layer of sound tissue, this may be done; if not, the limb affected may be amputated; if seated where there is a doubt respecting its limits (as is often the case in the neck) and where amputation is inapplicable, instrumental interference of any kind will only hasten the patient's destruction.

III. *Muscles.*

Encephaloid tumours originate in the cellular membrane separating the fasciculi of muscular fibres, but they acquire no peculiarity from their situation, and follow the same course as subcutaneous growths.

IV. *Subcutaneous Glandular Parts.*

1. Non-secreting. (a.) *Lymphatic Glands.*—Primary carcinoma of the lymphatic glands, of most common occurrence in the groin, axilla, and neck, is generally of the scirrhous species. In the early stages it may be undistinguishable from chronic induration and hypertrophy; the inefficacy of treatment of any kind being in some instances the first circumstance which excites a suspicion of the nature of the case. After having been for a certain time smooth and even, the enlarged gland becomes knotty. The subsequent progress of the disease is that observed in scirrhus of the mamma, but ulceration is more slow to occur; and in many cases a sort of excoriation of the investing skin attended with ichorous discharge, and alternately healing and opening afresh continues for a length of time. Of this mode of progress of the disease an excellent example is contained in Mr. Travers' Essay (Op. cit. vol. xvii. p. 365.)

Encephaloid disease more rarely originates in these structures. One of the most remarkable cases of this kind on record, in which both the external and internal glands were affected, was observed by Dr. Carswell at the Hôpital St. Louis, and has been published by Dr. Hodgkin[1]. The spleen and tonsils were the only other parts diseased in the same manner. A somewhat similar case is related by Mr. Wardrop (p. 157). These are decidedly unfavourable cases for operation.

(b.) *Thyroid Gland.*—Unless as a complication of pre-existing encysted disease or other form of bronchocele, cancer of the thyroid gland is singularly rare. Under the former circumstances scirrhus is the species in which the disease most commonly exhibits itself.

The case recorded by Velpeau, and already frequently alluded to, furnishes an excellent example of carcinoma of this structure, perfectly independent of adjoining cancer or of any preformed disease in the part itself. "The thyroid gland contained about a dozen cancers, all perfectly round, dense, elastic, and of a slightly yellowish white colour. The section of these presented a blueish tint, and when cut into slices the transparence, characteristic of scirrhous tissue, became apparent. The largest of them equalled a pigeon's egg in size, the smallest was less than a pea in bulk. All of them were easily separated from the substance of the gland (which was itself perfectly healthy) and were simply in a state of contiguity with it[2]."

Scirrhus of the thyroid gland is distinguished, according to Bayle, from ordinary bronchocele by its greater hardness and more uniform consistence in all its parts. It rarely presents that regularity of form which goîtres almost always retain; if it be lobulated, its lobes are much less distinct than those of the latter disease. It may affect the entire gland or only one of its divisions.

The same observer acknowledges the impossibility of ascertaining with certainty, during the life of the patient, whether an indolent bronchocele does or does not contain some portions of scirrhus or encephaloid; but the absence of these diseased formations from other organs is a presumption against their existence in the thyroid gland.

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[1] Travers, Op. cit. vol. xvii. p. 394.
[2] A. Cooper, Surg. Essays, Part i. p. 194.

[1] Med. Chir. Trans. vol. xvii. p. 90.
[2] Cas Remarquable, &c. p. 40.

The operations which may be undertaken for the extirpation of a cancerous thyroid gland are described in the article Goitre.

(c.) *Thymus.*—The language of some of the older writers would lead us to suppose that carcinoma of the thymus is far from uncommon. Haller[1] affirms that this organ "frequently becomes enlarged and affected with scirrhus, along with the conglobate glands;" that it "passes into a state of scirrhus, as he and others have seen[2]." Haugsted[3] justly concludes, that where no description is given of the affected parts, the accuracy of such phrases may be questioned: it is more than probable, indeed, that Haller simply meant to describe induration in using the term. Lieutaud[4] is sometimes more precise in his description of the "scirrhous thymus," and in these instances the affection appears to have been of tuberculous character. The characters of cancer of this organ—for though beyond doubt it can rarely, judging from the poverty of modern observations on the subject, be the seat of the disease, yet there is no reason to suppose it exempt from it—remain to be investigated.

2. Secreting. (a.) *Mamma.*—Carcinoma of the breast either occurs as a tumour not intimately involving the tissue of the gland in its early stage, superimposed, as it were, on the surface of the organ and seated among the adipose matter investing it; in which case the adjoining cellular membrane often furnishes a very distinct pseudo-cyst: or the carcinomatous matter is infiltrated in the substance of the organ.

When occurring in the first and much the more common form, the disease commences by a small induration, rounded, circumscribed, rolling under the fingers, perhaps most frequently seated in the axillary portion of the gland, giving rise to no pain, and productive of no real inconvenience. As it advances in growth, the surface becomes irregular and knotted, the tumour loses its mobility from the spread of the disease to the tissue of the gland, the occurrence of engorgement in the cellular membrane, or the contraction of adhesions with the skin. At this period the characters of this form of the affection resemble those belonging to the infiltrated variety from its earliest development, as far as the substance of the mamma is concerned. In the infiltrated form the carcinomatous matter affects the glandular structure from the first, increases the weight, density, and size of the organ, and never constitutes a distinctly *superadded* tumour.

The morbid mass, which was at first sunk in the general adipose and cellular substance of the breast, gradually becomes prominent; the adhering skin, having first grown more shining and white than natural, acquires a reddish or livid colour, generally mottled; the veins of the surface become enlarged and varicose; the nipple loses its prominence, and ends by sinking more or less deeply below the level of the surrounding skin, which is distinctly furrowed or puckered. The mechanism of this subsidence of the nipple differs in various cases: it may either depend on irregular adhesion of the mamma to the skin; on the traction exercised on the part by the obliterated and contracted galactophorous tubes; on atrophy of the proper structure of the gland; on thickening of the skin surrounding the nipple (here it is only apparent); or on carcinomatous infiltration of the latter part itself. In a variable point of the mass, sometimes before, but generally after certain evidences of internal softening in the tumour have occurred, the skin corresponding to the most elevated part undergoes the series of changes elsewhere described, and at last gives way. A serous fluid is at first discharged through the resulting fissure; the latter exhibits the characteristic progressive changes, ulceration spreads, soft or hard vegetations form on the ulcer, hæmorrhage and the usual phenomena of cancerous destruction succeed with greater or less regularity and frequency. The affection of the lymphatic system follows here its usual course; the glands of the axillary and supraclavicular regions suffer most considerably, and the obstruction to the circulation of the contents of the lymphatic vessels leads to extensive swelling of the hand, fore, and upper arm. This œdema may in advanced cases become of the hard kind with prominence of the cutaneous papillæ, and simulate a state of elephantiasis. It is sometimes complicated with frequent attacks of erysipelas, each of which permanently increases the size and hardness of the limb. This condition may form the chief source of suffering, and exercise all the endurance of the patient and ingenuity of the medical attendant. In these extreme cases M. Cruveilhier has discovered complete obliteration of the superficial and deep seated veins of the axilla. The œdema may extend to the trunk and lower extremity.

The local symptoms present here no particular characters: yet the suffering is perhaps more than usually severe in this organ. The period of the first occurrence of pain is very variable; the patient is said to feel worse before each catamenial period, but this is far from being of uniform occurrence. The discharge of a small quantity of blood or serosanguineous fluid by the nipple is sometimes, as already noted, a symptom of early occurrence, and may be useful in a diagnostic point of view.

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[1] Opusc. Pathol. Obs. 45.

[2] El. Physiol. t. iii. p. 119.

[3] Thymi in Homine ac per seriem Animalium, Descript. Anat. Pathol. et Physiol. Icon. 34, illustrat. Hafniæ, 1832.

[4] Hist. Anat. Med. t. ii. pp. 118, 851, p. 90. Obs. 761, 763.

The cachexia commonly exhibits itself in an intense degree, and the patient, who has usually suffered from thoracic symptoms, such as cough, oppression, and dyspnœa, sinks at last, death being not uncommonly accelerated by inflammatory effusion into the pleura, or simple hydrothorax, accompanied with more or less pulmonary œdema, and with or without cancerous patches under the pleura[1]. Aged subjects, who die from causes independent of their cancer, frequently go off in an attack of senile pneumonia; the latent character of inflammatory affections in old persons points to the necessity of ascertaining the physical state of the chest in such cancerous subjects, when the least suspicion of pectoral disease arises. According to Bayle, leucorrhœa of fetid character is a very uniform attendant on the closing stage, and does not necessarily depend on structural disease of the uterus; this is also true of the pain in the loins occasionally observed in the course of mammary cancer. Severe suffering is sometimes experienced in the back between the shoulders; this has been found by Sir A. Cooper to depend on carcinoma of the vertebræ. In a case of scirrhus of the breast observed by Sir B. Brodie sudden paralysis of the inferior extremities occurred two months before death. On post-mortem examination several of the dorsal vertebræ were found to have been converted into cancerous matter, and the lower portion of the theca vertebralis was filled with a serous fluid. The state of the spinal medulla however, is not mentioned[2]. In the majority of cases death occurs before the total destruction of the mamma; in others the ulcer extends from the axilla to the lower border of the pectoralis, while its basis is formed of the thickened pleura and ribs. These bones are sometimes cancerous, though the intervening muscles continue sound.

Scirrhus is incomparably the most frequent species of primary cancer in the breast. Encephaloid, however, sometimes occurs, either of the solanoid or true cerebriform varieties, or of both combined, the former forming the basis from which the latter springs; or the morbid growth originates in the wall of a simple or multilocular cyst with fluid contents, and assumes a phylloid, pedunculated, or irregularly tuberiform shape. The latter is regarded by Mr. Travers "as the primitive form of medullary cancer, when it appears in the region of the mamma;" but this opinion is at variance with the experience of others. Colloid is occasionally witnessed in this situation; in the majority of instances forming part of a composite tumour.

Deposition of scirrhus in the infiltrated form may commence in either of the component tissues of the gland. M. Velpeau establishes three varieties of the disease, according to the tissue primarily affected. In the *ramose* variety the morbid action originates in the cellular laminæ dividing the lobes of the gland; an unequal, hard, ill circumscribed tumour, which terminates insensibly in radiating indurated bands among the adjoining cellular membrane, is the result. In these cases it is almost impossible to assign accurate limits to the disease, as the bands in question extend sometimes even to the axilla or twist under the border of the pectoralis major; the importance of tracing them to their apparent termination in extirpating the disease has justly been insisted on by a number of writers. The true *glandular* variety (the *granulated* scirrhus of Mr. Travers?) commences by the lobules of the gland. Here the tumour is knotted, wrinkled on the surface, moveable, tolerably well circumscribed, and firm. The form referred to by Mr. Travers is stated to occur most frequently at the axillary border of the organ, and may attain a large size, mainly because most commonly developed in full-breasted women. In the third variety, the *lactiferous ducts* are the chief seat of the disease. In four or five cases of this kind examined by M. Velpeau the tumour was flattened from before backwards, not very painful, half as large as an ostrich's egg, slightly tuberculated, and non-adherent. On section it was found to consist of ordinary scirrhus, speckled with small spots like granite, and presenting a number of minute open orifices, filled with caseous matter. This appears to be Mr. Travers' *spiculated* scirrhus, which is seated "chiefly among the tubes and towards the nipple." It is hardly necessary to add, that with the progress of the disease these distinctions, founded on the tissue affected, are lost, as the entire structure becomes involved. Mr. Travers well remarks, that as such characters are not dependent on the nature of the disease, but the anatomical constitution of the organ, they may exist in other species of growth.

In some cases the course of the disease in respect of the skin is not such as we have represented it. This membrane appears occasionally to undergo the cancerous transformation coevally with, and as it were independently of, the subjacent tissues; or, as Mr. Travers, Bégin, Cruveilhier, and others have observed, the disease in rare instances actually commences with the skin. The natural suppleness, elasticity, and colour of this tissue are lost, it acquires a dusky brownish hue and coriaceous hardness, becomes at a variable period studded with miliary pisiform scirrhous excrescences (most commonly of the leucoid and mollusciform varieties according to Rayer) which successively undergo superficial abrasion; these minute ulcerations extend, become continuous, and form a single wide-spread ulcer. This variety may commence in the nipple.

The *atrophous* and *hypertrophous* forms of scirrhus are both observed in the mamma. The former is most common in subjects of advanced age; its progress is usually slow. M. Cruveilhier relates a case showing the extreme degree to which the atrophy may advance; here the skin, cellular tissue, mamma, and a stratum of the pectoralis were converted into a stony mass only half an inch thick.

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[1] In a singular case, related by Cruveilhier, the occurrence of pleurisy, acting like a counter-irritant, appears to have retarded the progress of the cancer, though it proved itself, eventually, the cause of death. Vide Livr. xxxi.

[2] On Dis. of Joints, Ed. 3. p. 283.

Cancer is very commonly confined to one breast, the left being somewhat the more frequent sufferer; in cases where both organs are affected, the disease attacks one consecutively to the other; we do not recollect to have seen or read of an instance of the disease commencing in both simultaneously. Sometimes the two breasts are connected by indurated absorbents, or a chain of small cutaneous scirrhi.

The question of the causes of mammary cancer merges in that of the etiology of the disease in general. It is said to be more frequent in women who have not borne children, whether married or single, than in mothers, and its evolution connected with the disappearance of the catamenia: the former proposition requires stronger proof than has yet been given, before it becomes entitled to general confidence; of the latter we have already spoken.

Cancer of this organ is almost peculiar to the female sex; occasionally, however, it occurs in males, and appears in them to follow the same course as in women. It originates either in the nipple or its immediate vicinity. Mr. Travers relates the case of a waggoner, aged 58, in whom the disease, first perceived as a lump the size of a marble in the left breast, acquired in the course of three years the dimensions of a pullet's egg, and proved fatal (there was similar deposition in the lungs) in the course of forty months. Cruveilhier refers to a mammary tumour successfully removed from the breast of a carter aged 70.

We have no statistical documents to decide with precision the period of greatest frequency of the disease or the influence of age on its production. Although Mr. Carmichael has seen scirrhus of both mammæ in a child aged 12, and Everard Home relates an instance in which it commenced at the age of 15, its occurrence before thirty is extremely uncommon; persons of the most advanced age are not exempt from the chance of its development. Sir A. Cooper has seen it in an individual aged 86, and Cruveilhier maintains that such facts are of almost too frequent occurrence to be looked on as exceptional. Mammary encephaloid of the most acute character has been witnessed at the age of 82.

Scirrhus of the breast is, according to Sir A. Cooper, from two to three years in growth, and from six months to two years in destroying life after it has reached its acme. When occurring in advanced age its progress is ordinarily slower: and to the remarkable exceptions sometimes met with we have already adverted. Mr. Travers and others affirm that the advance of the disease is retarded by utero-gestation. Velpeau estimates the mean duration of encephaloid of this organ at from six to twelve months.

Although no single character suffices to distinguish a scirrhous tumour from certain other diseases to which the mamma is liable, yet a combination of the signs we have described will usually ensure tolerable certainty of diagnosis. If a hard, moveable, indolent tumour, of small size, insensible under immediate pressure, but becoming painful a short while after manipulation, has existed in the breast of a female, aged thirty or upwards, for a certain period—say from six months to a year—the probability is strongly in favour of its being cancerous: this probability will amount to positive certainty, if either previously to, or at the end of, this period, lancinating pains alternating with perfect freedom from suffering supervene, and the disease resist local antiphlogistic and discutient measures. The state of the constitution will in general facilitate the diagnosis; but too much stress may very easily be laid on the absence of general disturbance. We have seen tumours, of which the truly scirrhous character was anatomically demonstrated, removed from women whose general health was excellent; and it has been remarked by a close observer, Bayle, that women sometimes become apparently even healthier than before during the incipient stage of mammary cancer. The signs of encephaloid growth in the breast, if combined in any number, can rarely mislead. The diseases with which the two species of cancer are here most likely to be confounded, are local or general hypertrophy or fibrous tumour in the case of scirrhus, and multilocular encysted formations in that of encephaloid. The whole subject of the differential diagnosis of mammary affections will be found treated of in the article Mamma.

The general principles we have laid down respecting the prognosis and treatment of cancer, the propriety of and period fittest for operating, are strictly applicable to the disease in the breast. Enlargement of the axillary glands forms, according to Sir A. Cooper, Velpeau, and others, a positive contra-indication to the use of the knife: the fact of such enlargement diminishes seriously the chances of ultimate success, but general experience proves that what we have already said on this point applies to the mamma. The existence of retraction of the nipple diminishes still further the probable utility of extirpation; and the operation is inadmissible if there be active disease of the pleura or lungs. It is almost unnecessary to add, that the *ramose* variety is less favourable than the *tuberiform* or *glandular* for operation. Sir A. Cooper thinks that scirrhus does not return in one fourth of the cases of removal; Mr. Warren that one case in three is cured; Mr. Travers that permanent recovery "generally" ensues when the disease is removed before the supervention of pain: to the extreme and opposing opinions of Hill and Boyer we have already sufficiently referred. Among 98 amputations of the mamma performed by Benedict, two terminated fatally before the wound had closed; in 83 cases the disease returned after cicatrization, and proved fatal "more rapidly than if no operation had been done;" in 13 no relapse was heard of, but Benedict was morally persuaded that some of these cases were not truly scirrhous[1]. The hopes of perfect and lasting restoration after the ablation of encephaloid are faint indeed; yet even here we need not wholly despair of success; M. Velpeau has excised well-marked specimens of this species, and seen the patients in perfect health two, four, six, and in one case ten years afterwards. When encephaloid grows from the walls of a simple or multilocular cyst containing serous fluid, the operation of puncturing the cyst and drawing off its contents accelerates the growth of the superadded cancer. The removal of pressure, as elsewhere explained, sufficiently accounts for the effect of such operation. Dupuytren in cases of this kind enucleated the cancerous masses, and stuffed the cyst with shredded lint to promote cohesion of its walls.

The manual part of the operation is described in the article just referred to.

Œdema of the arm must be treated by position, and on general principles. When occurring in the extreme form spoken of, little of an effective kind can be done for its relief; M. Cruveilhier has in one such case had recourse, "with some advantage," to leeches, blisters, and scarification: *melius remedium anceps quam nullum?*

(B.) *Salivary Glands.*—The salivary glands are rarely affected with scirrhus or encephaloid, and colloid cancer has not been observed in these organs. Of the numerous cases reported by writers as examples of cancerous disease of the parotid for example, there are but few indeed in which it is not highly probable—in the majority this is certain—that the lymphatic glands of the neighbourhood were the real seat of the morbid deposition. Tumours thus constituted press upon the parotid, and reduce it by gradual absorption to a thin lamina, which is easily overlooked in the wound, resulting from their ablation.

Secondary scirrhous enlargement of the submaxillary and sublingual glands, however, is not of very uncommon occurrence in the course of, or after the removal of cancerous disease of the lip, adjoining skin, or tongue. It is certain, also, that scirrhus and encephaloid both occasionally originate in the parotid. The disease runs its ordinary course in this gland, nor is there any particular point to be noticed except the effects of implication of the fifth and seventh pairs of nerves. In a case observed by Magendie, "there was complete loss of sensibility in the corresponding side of the face, destruction of vision in the eye of that side, ulceration of the cornea, insensibility of the organ, not only to light, but under the contact of foreign bodies, deviation of the mouth to the opposite side, &c.[1]"

The parotid and submaxillary glands thus affected may be made the subject of operations, the mode of performing which is described in the articles under those heads. One of the most remarkable operations of this kind on record was performed in 1823 by Béclard: the parotid was here indubitably affected with scirrhus[2].

V.—*Nerves.*

See Eye, Neuroma.

VI.—*Bones, Periosteum and Endosteum*[3].

(A.) Bones.—Cancer presents itself in the tuberous and infiltrated forms. The tuberiform variety occurs in the cancellated structure of the short and flat, and both in that constituent part and in the central cavity of the long, bones. The subjoined cuts exhibit its appearance in the body of the vertebræ, and in the spongy tissue of the head of the femur.

Fig. 162.

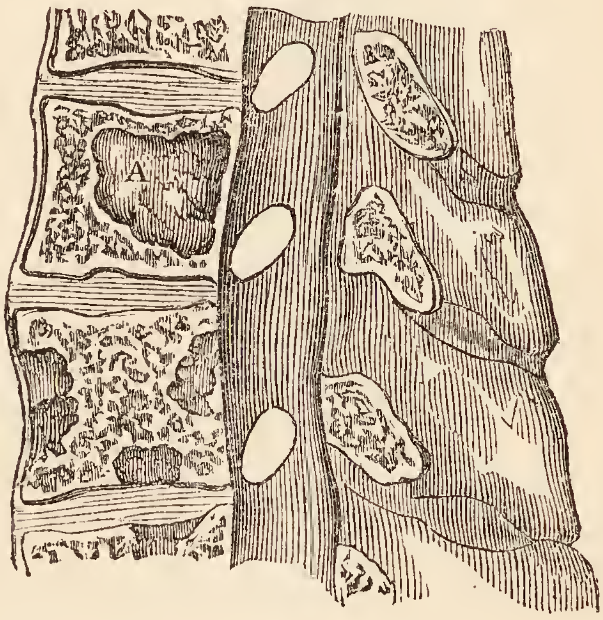

Fig. 162.—A, *Tuberiform scirrhus in the bodies of the vertebræ. The compact substance was destroyed in some of these situations.*

Fig. 163.—*Femur fractured at* D, *the compact tissue having been worn to a thin lamina in that situation by a large tumour;* A, B, C, *carcinomatous tumours;* m, *the medulla.*

Both these figures (copied from Cruveilhier's Livrais. xx.) *were made from the bones of a subject affected with mammary cancer; her death had been accelerated by fracture of both femora.*

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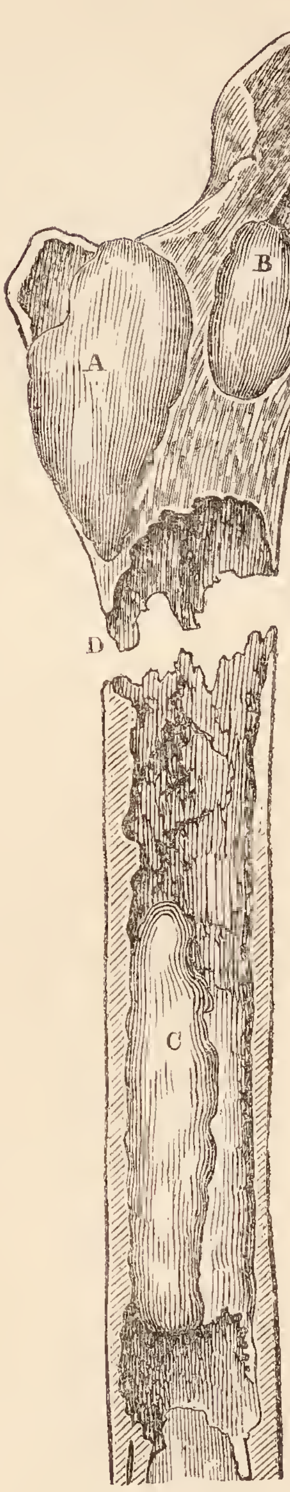
[1] Rust's Magaz. b. 44, s. 191. 1835.

[1] Lectures on the Blood, Lancet, Nov. 17, 1838.

[2] Arch. Gén. de Méd. Jan. 1824.

[3] We take the liberty of proposing the word *endosteum* (formed on the model of endocardium) as a convenient substitute for the phrase, "lining or medullary membrane of the bones."

Fig. 163.

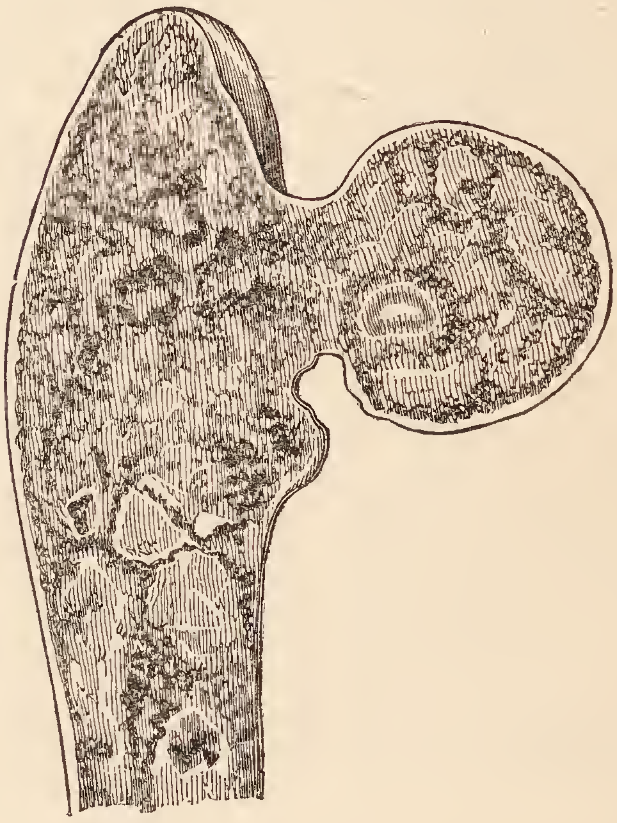


The compact substance, according to Cruveilhier, appears, so long as it retains its natural structure, insusceptible of becoming the seat of cancerous formation; but the facility of its transmutation into spongy tissue explains the occasional discovery of the morbid matter in the situation of the shell of the bones.

The shape of these growths is exceedingly various, but appears in the cylindrical bones to be somewhat influenced by the form of their central cavity. They are either of the scirrhous or encephaloid species; in the majority of cases, of the former. The firmness of scirrhus thus situated is ordinarily very considerable, and Cruveilhier considers it only distinguishable from fibrous tumour by its furnishing cancerous juice under pressure.

Tuberiform cancer, either primary or secondary in these structures, is most commonly of the latter kind. It appears to attend mammary cancer more frequently than others, though by no means exclusively—witness among many proofs of this an interesting example, related by M. Cruveilhier, of its development in the vertebræ and ribs of a subject who had had a testicle removed for encephaloid disease six months before death. Other instances of the kind will be referred to in subsequent pages. This form of cancer is not attended with abnormal development or expansion of the shell of the bones in which it originates; it resembles, on the contrary, the atrophous form of cancer in the soft parts, being commonly accompanied with molecular destruction, or absorption of the osseous tissue.

Fig. 164.



The general disposition of *encephaloid* matter *infiltrated* through the spongy tissue of the femur is shown in fig. 164. The compact tissue is reduced to a lamina of extreme tenuity; the disease extended considerably further down the bone. For an example of pultaceous infiltration we refer to the section on cancer of the meninges (fig. 165).

When carcinoma occurs in the bones, as a mere evidence of the diathesis being established in a person with primary cancer elsewhere, it rarely, if ever, acquires such magnitude as to cause external tumour; when the osseous tissue is the original nidus of the morbid matter, the case is different, and enlargement, visible externally, is produced in two distinct ways. 1. The deposition having occupied the entire of the cancellated structure, the investing shell may, as has been mentioned, be destroyed by preparatory conversion into spongy tissue and subsequent cancerous infiltration,—or absorbed from the pressure of the enclosed mass; in either case the morbid growth escapes under the periosteum, and then rapidly augments in size, while bony spiculæ sprout into its substance from the surface of the yet unabsorbed shell. (See fig. 168.) 2. Or the compact tissue may be immensely expanded, and form, as it were, a vast osseous sac, encasing the morbid formation,—in some parts of tolerable thickness; in others, reduced to a mere parchment-like lamina; in others, perforated from absorption: this is one of the diseased conditions to which the term "spina ventosa" has been applied.

The articular cartilage investing the head of a bone thus expanded, was invariably free, in such cases as we have had an opportunity of examining, from cancerous infiltration; though frequently in contact with the morbid matter deposited in the bones, the cartilage simply undergoes attenuation and elongation from the traction exercised on it by the expanding osseous tissue. We have elsewhere mentioned the opinion of M. Cruveilhier respecting the frequency with which this expansion depends on colloid cancer. We are, however, disposed to believe that true colloid is singularly rare in this situation, and that the affection thus designated, and of which numerous specimens are described by writers and preserved in museums, is really that recently termed *enchondroma* by Müller, and chemically characterized by containing a peculiar form of gelatine, known as *chondrin*. The German author, indeed, (s. 44) dwells upon osseous expansion as one of the conditions distinguishing enchondroma from cancer. But that the latter, when of the encephaloid species, does occasionally produce this phenomenon, appears from the preparation No. 159, in the museum at St. Bartholomew's, as likewise from the testimony of Sir A. Cooper and Sir B. Brodie. The latter surgeon amputated the thigh of a boy aged fourteen, for a tumour eighteen inches in circumference—"this tumour was found to be wholly formed by an expansion of the head of the tibia: its upper and inner part was composed partly of cysts containing a bloody fluid, and partly of organized medullary substance[1]."

(B.) Periosteum.—The periosteum, or more commonly, the cellular tissue uniting it to the bones, may be the sole seat of cancerous disease. As an example of scirrhus originating in this site, the following case, by M. Cruveilhier, may be related. An inmate of the Salpêtrière, aged about fifty, observed a swelling at the upper part of the sternum two or three years after having had a cancerous breast removed. It gradually increased to the size of the fist, spread along the right clavicle, and eventually ulcerated in several points; meanwhile tumours, perceptible to the touch, formed in the liver. On post-mortem examination, the internal two-thirds of the clavicle were found very much enlarged, and of fusiform shape: the external third was slender. The tissue of the bone had a healthy aspect, being only corroded superficially, and the morbid formation limited to the periosteum: this membrane "formed a dense firm cylinder, of fibrous tissue, infiltrated with cancerous juice (scirrhus); the corresponding part of the medullary membrane was thickened, and, as it were, infiltrated with serosity." (Chronic endosteitis?) The sternum was infiltrated with cancerous matter, and the disease had spread thence to the pectoralis major, and skin; reversing the more ordinary course of things, in which the affection of the skeleton is consecutive to that of the soft parts.

Periosteal cancer much more commonly exhibits the encephaloid character; and has been described by Sir A. Cooper under the title of "fungous periosteal exostosis." "The swelling," says this distinguished writer, "is lobulated; the greater part of it is composed of a white substance, somewhat elastic, but firm, and not so firm as common cartilage [hard encephaloid]; part of it is coloured by blood, and the texture of this part is softer than the rest. When injected it shows a very unequal vascularity." The periosteum investing the mass is sometimes enormously thickened, and an abundant mass of bony spiculæ disposed in radiating lines, and continuous sometimes with cartilaginiform fibrils, is observed in the substance of the growth.

(C.) Endosteum.—In the majority of cases of cancer of the spongy tissue of the long bones, there is coexisting disease in the lining membrane of their cavity. Now, if Cruveilhier's opinions be correct, that the compact tissue does not ever, while retaining its characteristic properties, give origin to cancer, and that, as is believed by others also, carcinoma of the spongy tissue originates not in the osseous texture itself, but in the expansion of the central membrane lining these—the immediate seat of cancer in the bones is limited to the endosteum. But as these points are far from established, we have given a figure placing the possibility of distinct origin of the disease in the cylindrical portion of that membrane beyond a doubt. The growth C, in fig. 163, furnishes sufficient evidence by its situation and form, that such may be the nidus of cancerous matter.

The disease may co-originate in the cancellated structure, central cavity, and periosteum of the same bone. It may be limited to a single bone, to a single region of the skeleton, or affect a considerable number of these in the same subject. The bones of the extremities, the ribs, vertebræ, clavicle, maxillæ, cranium, and pelvis, are all observed seats of the affection.

Further illustration of this subject will be found in the following section; and for the practical consideration of it we refer to the articles Maxilla, Osteo-sarcoma.

VII.—*Meninges.*

(A.) Cerebral and Cranial Meninges.—It is unnecessary in a work of this kind to trace the successive steps by which pathologists have ascertained that the disease described by Louis under the title of "fungus of the dura mater," is of cancerous nature, and may originate in any of the following situations:—1. Dura mater, (*a.* external laminæ, *b.* internal); 2, Pia mater; 3, Cerebral substance; 4, Cranial bones; 5, Sub-pericranial cellular tissue[1]. For an historical sketch of the subject we beg to refer the reader to the different productions quoted in the following pages, but especially to the elaborate volumes of the Wenzels, Ebermaier, and Chelius; and shall content ourselves with laying before him a brief abstract of the present state of knowledge respecting it.

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[1] On Dis. of Joints, p. 289, Ed. 3, 1834.

[1] Cancerous tumours developed in some of these situations cannot, in strict arrangement, be referred to the head of meningeal growths—but as they are closely connected symptomatically and therefore practically

The errors of the older observers testify strongly to the *encephaloid* character of fungi of the dura mater: these tumours were in fact by early surgeons[1] in numerous instances mistaken, from the appearance of their constituent materials, for herniæ of the brain. The fact, however, now rests upon surer foundation: that perforating fungous tumours of the meninges are in the majority of cases composed of this tissue is now fully established by the combined testimony of the elder Siebold, Ebermaier, Graff, Schnieber, Otto, Wishart, Abercrombie, Schindler, Chelius, Cruveilhier, Velpeau, &c. But true *scirrhous* tumours also spring from the meninges and destroy the investing bony substance, as appears from M. Velpeau's *Cas remarquable;* here a tumour of this description made its way partly through the occipital bone: M. Cruveilhier's plates exhibit some examples of meningeal cancer belonging to this species, and others have been described by German investigators. Areolar pultaceous cancer has been found in the cranial bones.

Seat 1. *Dura mater: (a.) External lamina, or surface.*—Such is still believed by the generality of surgeons to be the sole seat of fungous growths exhibiting themselves in the form of a tumour on the exterior of the cranium. This opinion, originating with Louis, received the support of the Wenzels[2], but was strenuously combated by Walther and others on the evidence of some cases observed by themselves, in which the morbid matter distinctly sprang from other sources. Independently of those referred to or related by Louis and the Wenzels, there are several others on record proving that the external surface of the dura mater may be the nidus of these growths. Klein, for example, states that, in a case which he had an opportunity of treating, the tumour was detached without the least difficulty from the perforated bone, from which it appeared to be separated by a particular membrane, and was in organized connexion with the external surface of the dura mater alone. Wedemeyer observed a tumour growing from precisely the same seat, in respect of tissue, and protruding through the frontal bone. In the case of M. A. Bérard the deep surface of the dura mater was perfectly healthy, and the tumour, unconnected with the osseous tissue, extended laterally on each side of the perforation, separating the former from the latter. Mr. Travers and Mr. Mackenzie relate equally convincing cases. Richerand goes so far as to affirm that it is rare to open an old subject without finding heterologous tumours on the external surface of the dura mater: Boyer, with less inclination to exaggerate, contents himself with commenting on their frequency. In their incipient stage they form small grayish vegetations, are exceedingly firm, and of "lardaceous" aspect.

(*b.*) *Internal lamina or surface.*—The precise locality of cancerous growths developed in this situation is in all probability the cellular tissue connecting the dura mater and parietal arachnoid; and they are certainly of more common occurrence here than on the cranial surface of the former membrane. Why they should not so frequently come under the notice of the surgeon as the class just noticed will presently appear. Carcinomatous tumours of the serous surface of the dura mater have been observed by Gondanges, Baillie, Hebreard, Meckel, Otto, Wishart, Ebermaier, Cruveilhier, and Velpeau. Chelius refers to six specimens of the disease contained in the Strasburg museum; and in one of his plates represents cancerous tumours co-originating on both surfaces of the fibrous membrane. Dr. Bright has also figured specimens of the disease in this situation, and shown, with Ebermaier and others, that the so-called glands of Pacchioni may give origin to it. The ordinary tendency of cancers developed in this situation is, as remarked by Otto and Cruveilhier, to grow inwards and depress the brain; under these circumstances they strictly belong to the department of medical pathology. But in comparatively rare instances they manifest an opposite disposition in respect of their growth, press on the skull, determine absorptive destruction of its substance, and protrude externally. In one case described by Cruveilhier, protrusion had actually occurred; in another perforation was in progress: one of the internal meningeal tumours discovered in the subject of Velpeau's *Cas remarquable* had partially perforated the occipital bone.

2. *Pia mater.*—A specimen of cancerous growth, originating either in the pia mater itself or in the cellular tissue uniting it to the arachnoid, is figured by Cruveilhier[1]: although there was no perforation here, there can be no doubt that such effect might arise from the presence of a tumour in this situation, as sometimes happens when they are still more deeply seated. Dr. D. Munro[2] long since described a tumour, evidently encephaloid, growing "on the brain," and which had perforated the frontal bone: J. Hunter refers to a perforating growth originating, as he believed, from the pia mater[3]: Mr. Mackenzie[4] is of opinion

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with these, we have thought it advisable to consider them in the same place. Here might also be included encephaloid growths originating between the skin and the fascia of the scalp.

[1] A. Paré, Pauw, &c.

[2] The Wenzels, however, admitted on the evidence of Sandifort's case and of another observed by themselves, that the disease may be developed in the cranial bones.

[1] Livr. cit. Pl. 3, Fig. 3.

[2] Med. Trans. vol. ii. p. 353; Lond. 1772.

[3] On the Blood, vol. ii. p. 337; 1812.

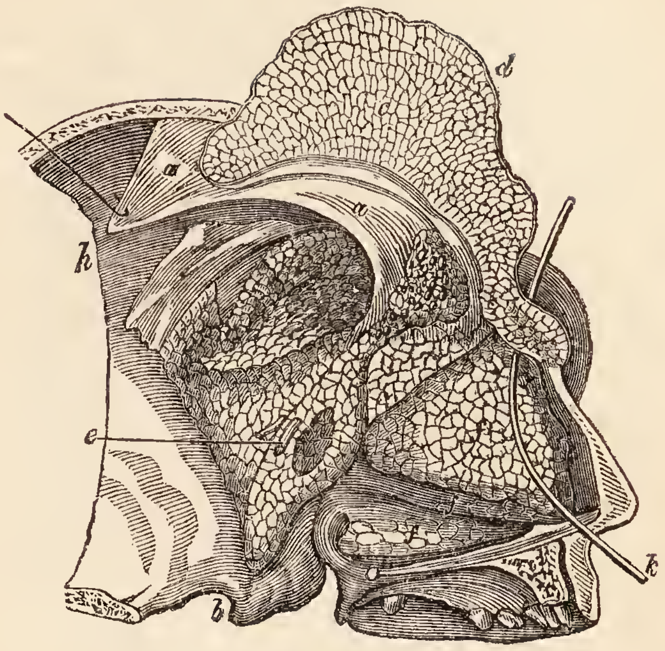
[4] On Diseases of the Eye.

that both descriptions refer to the same case.

3. *Brain.*—Ebermaier mentions two cases of cancer of the cerebral substance attended with absorption of the corresponding part of the cranium. In one of these the internal table and diploe of the right parietal had disappeared to a considerable extent, and the outer lamella was attenuated and even perforated. An encephaloid tumour weighing four ounces disclosed itself, on post-mortem examination, in the substance of the right hemisphere; the investing arachnoid and pia mater were in the normal state. That protrusion would have occurred here, had the patient lived longer, is rendered next to certain by a case subsequently watched by Ebermaier himself[1]. In this instance a fungous tumour, protruding from the cranium, and opened with caustic during life, was found to have taken its origin from the left hemisphere. Mr. Travers "has a preparation exhibiting a genuine example of encephaloid affecting the anterior lobe of the cerebrum and protruding the eye from its socket, while the eye itself was perfectly free from disease[2]."

4. *Bones.*—C. v. Siebold believing, on the authority of two cases he had met with, that the disease always originated in the diploe (an opinion which seems to have been that of Sandifort, Kaufmann, and Heister) termed it fungus of the skull. But though the error of this notion, as an exclusive doctrine, is now thoroughly established, it is equally certain that these growths do frequently spring from the cranial substance. Passing over the cases just referred to, one of the tumours described by Wishart was evidently thus seated; the same may be said of Eck's case; a fungous mass, as large as an infant's head, observed by Schindler, grew from the tissue of the frontal and ethmoid bones. The chief connexions of an encephaloid growth described by Graff were with the diploe and compact substance of the bone; some trifling adhesions only brought it into organised relation with the dura mater and integuments. Velpeau refers to a most conclusive case, on the authority of Lauth of Strasburg, in which a tumour of fungous character had formed between the tables of the parietal bone. The diploe is commonly the immediate seat of the morbid formation in these cases; but Graff's case, as well as the admirably minute description by Ebermaier, of a cranial tumour, shows that the compact substance of the tables may be its nidus; whether with or without the transmutation of tissue described by Cruveilhier does not appear. The condition of the bones in the case of pultaceous alveolar cancer, related by the latter observer, is shown in the subjoined woodcut. Here the frontal, ethmoid, nasal, the body and wings of the sphenoid and the inferior turbinated bone, the pituitary membrane, and part of the dura mater were affected.

Fig. 165.



a, *Falx cerebri;* b, *foramen occipitale;* c, *chief substance of the tumour;* d, *surface of the os frontis;* e, *optic nerve;* f, *spongy bones;* g, *crista galli;* h, *parietal bone;* k, *sound passed through a fistula uniting the nares with the external surface.*

5. *Subpericranial cellular tissue.*—The chief tumour in Chelius's second case (that of a woman aged 58) was seated between the pericranium and bone, connected with the fibrous membrane at its line of union with the skull, and closely adherent to the osseous substance. The latter presented some small openings capable of admitting a sound, but no regular perforation. Chelius considers this growth a production from the pericranium itself; and his third case exhibits stronger evidence of the possibility of such origin. Blasius has also admitted, apparently however without having himself witnessed the fact, that the pericranium may be the primitive seat of the affection; but Ebermaier, in his latest production[1], questions the existence of pericranial fungus as a distinct formation. Chelius's cases seem at least to prove that cancerous growths may arise in the tissue intervening between the skull and its fibrous investment; and the fact is further established by a case observed by Mr. Langstaff many years back, wherein "a tumour was found at the vertex beneath the pericranium; it had affected the bone only in a slight degree[2]."

V. Walther, on the evidence of a single case, maintained that the disease was always constituted by a simultaneous change in the dura mater, cranium, and pericranium, but especially marked in the blood-vessels of the diploe. In Chelius's third case, all those tissues were evidently, in some situations, included in the morbid change; and such, too, appears to have been the fact in the individual operated on by Sir A. Cooper. On the fallacy of V. Walther's notion, as a general proposition, it is needless to insist.

Symptoms.—It will be necessary to examine separately the symptoms of meningeal cancer while within the skull and after its appearance in the form of a tumour externally: with the signs and symptoms of the latter may be united (in order to avoid minute divisions) those produced from the outset by cranial and subpericranial cancer—care being taken to point out the more important peculiarities characteristic of the latter.

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[1] Article in Encyl. Wörterb. s. 581.

[2] On Dis. of the Eye, 3rd ed. p. 228; 1824.

[1] Article in Encycl. Wörterb.

[2] Med. Chir. Trans. vol. iii. p. 288. 1812.

(*a.*) *Before perforation.*—Like intra-cranial tumours generally, meningeal cancer usually produces no symptoms in its early stage: the pressure undergone by the brain is attended with no interruption of its functions, either on account of the slow growth of the tumour, or of the cerebral atrophy which proceeds *pari passu* with the enlargement of the adventitious mass. At a variable period, however, according to a well-known peculiarity in cerebral pathology, the compression produces manifest effects, and these may occur so suddenly and assume such a character as to simulate the symptoms of an attack of cerebral hæmorrhage. Thus, sudden loss of senses, followed by hemiphlegia, has been noted as an effect of intra-cranial cancer, or rather of the anatomical changes to which this gives rise; but in other cases—and these, fortunately for the facilities of diagnosis, would appear to be of much more common occurrence—the phenomena of compression arise gradually, the powers of feeling and motility in the limbs diminish by almost imperceptible degrees and are finally lost, while the intellectual faculties undergo a chronic process of stultification merging in complete idiotcy; in some instances the patient seems to be in a state of intellectual torpor only, and is capable of being roused into imperfect mental manifestation, as for instance, the returning monosyllabic answers to simple questions. In another class of cases the foreign body acts as an irritant, and produces some one of a variety of lesions announced by the supervention of severe pain and convulsive movements in the paralyzed limbs, or epileptiform attacks, occurring with greater or less frequency and violence. If these symptoms have been preceded by persistent cephalalgia in a fixed spot, the existence of intra-cranial tumour is rendered still more likely. The irritative changes thus produced—inflammation of the membranes, serous effusion under the cerebral arachnoid, or into the ventricles, common or capillary apoplexy, and white pultaceous or straw-coloured gelatiniform softening of the surrounding brain—are stated by Cruveilhier to be the most ordinary immediate causes of death in these cases: the cancerous nature of the tumour rarely, if ever, leads to the fatal result.

But masses of fibrous, calcareous, or of tuberculous matter may give rise to a similar train of phenomena; the question arises whether there are any means whereby the cancerous nature of the growth may be distinguished. As M. Louis has proved that, with the rarest exceptions, the presence of tuberculous matter in any organ involves, in subjects aged upwards of fifteen, its existence in the lungs, careful examination of the physical condition of those organs may lead to a determination of the nature of the cranial formation. If they are healthy, the latter cannot be tuberculous; if they are tuberculous, the chances are not only directly in favour of the intra-cranial tumour being composed of the same material, but against its being cancerous; for we have shown that the coexistence of carcinoma and tubercle in the same organism is extremely rare. But for the further consideration of these points we must refer the reader to works on medical pathology.

The seat of the tumour, admitting the fact of its existence to be established, is another problem of most difficult solution: the alleged locality of the cephalalgia is often a faithless guide[1]; and a tumour confined to one side of the cranium may, from affecting both hemispheres, give rise to functional disturbance of both lateral divisions of the body.

When some particular sense is paralyzed, we have an aid in localizing the disease; yet over-confidence in the positive or negative information thus obtainable may easily betray us into error. Professor Bérard[2] has related a case in which the olfactory nerves were destroyed by the pressure of a tumour, and yet the patient, according to the positive affirmation of the occupants of the beds adjoining his, enjoyed to the last the faculty of smell. Although not established with sufficient certainty to obviate all scepticism as to the reality of its occurrence, this fact was seized with avidity by M. Magendie as a triumphant argument for his doctrine of the functions of the fifth pair of nerves. In Graff's case there was a peculiar sensation of cold experienced in the throat and stomach, so that the hottest food seemed iced: a tumour was detected pressing on the medulla oblongata, the glosso-pharyngeal and vagus nerves. In a case of intra-cranial carcinoma destroying the trunk of the fifth nerve, and related by Mr. Bishop[3], a variety of symptoms, depending upon the lesion of that important trunk, arose, and might unquestionably have furnished materials for localization of the disease.

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[1] M. A. Severinus (De Med. Efficac. lib. i. part. 2. cap. 3.) refers to the case of a Spanish nobleman afflicted with violent headache which had resisted every kind of treatment; the sufferer consented to the application of the trepan over the seat of the pain. The operation brought into view a fungous excrescence, the destruction of which cured the cephalalgia permanently. But these bold proceedings have not always been crowned with similar success. Mr. S. Cooper "saw Mr. Ramsden trepan a man for a mere fixed pain in one part of the head, on the supposition that there was a tumour under the bone; but no tumour was found, and the operation caused inflammation of the dura mater and proved fatal." The subject of Lauth's case, to which allusion has already been made, had been trepanned before death in the situation of an obstinate local headache with which he had been tormented: the cancerous growth was discovered in the diametrically opposite part of the skull. On the other hand Wepfer relates an example of successful issue in a case like that of Severinus. (Obs. Med. Pract. De affect. Cap. Obs. 48. p. 119.)

[2] Thèses de Paris, No. 23, 1826.

[3] Med. Gaz. vol. xvii. p. 387. 1836.

When opportunities occur for making a post-mortem examination, in this stage of their progress, of tumours originating from the internal surface of the dura mater, these productions are in almost every instance found non-adherent to the substance of the brain; in some cases there is no adhesion visible between the cerebral and parietal arachnoid; in others these layers and the pia mater are firmly united, or false membranes present themselves in the cavity of the serous sac[1]. Some one or more of the changes already referred to are discovered in the brain, when irritation of that viscus has been the immediate cause of death.

But when, instead of growing inwards, cancer of the *internal* surface of the dura mater presses forcibly on the cranial substance, absorption and perforation, as we have already mentioned, follow. The characters of the protruding mass and of the perforation deserve notice. In one of Cruveilhier's cases, in which a distinct elevation was discovered under the scalp, (but not till after the patient's death,) this was found to form a spongy mass, consisting of a dense fibrous lamina, and a multitude of osseous vegetations mingled with softened matter. The skull was widely perforated; the internal table destroyed and replaced by encephaloid pulp to a considerable extent round the opening, the external forming a thin elastic scale within the same limits. Here the cancerous nature of the malady might almost be predicated with certainty, if the fact of perforation were established; but the protrusion might easily be mistaken for a fungus from the *external* surface of the dura mater—an error committed in the very instance referred to. We are not aware of any means by which the distinction could be made in the living subject: the mode of destruction of the bone is in both instances subject to the same variation. The cranial substance may either soften from carcinomatous infiltration; the internal table and diploe may alone be destroyed; or in addition the external may be rarified and cribriform from numerous minute perforations; or, as is the most common case, gradual absorption is effected in the same manner as in the case of post-osseous aneurism. From the direction and manner in which the opening is formed, it naturally follows that this should be much narrower externally than internally, the tables of the bone appearing bevelled off from without inwards. (See Fig. 166.) The edge of the outer table is usually thin, sharp, and uneven. While the process of destruction goes forward, rugged and irregular spiculated bony vegetations, as shown in Fig. 167, sometimes form on the external surface of the cranium. However compact the bony tissue may be, it is incapable of resisting this perforative process: M. Velpeau quotes the Thesis of M. Thibault[1] as supplying cases in which cancerous growths forced their way through the petrous process into the meatus externus. In cases where the walls of the nares have been perforated, epistaxis has almost constantly been noted.

Fig. 166.

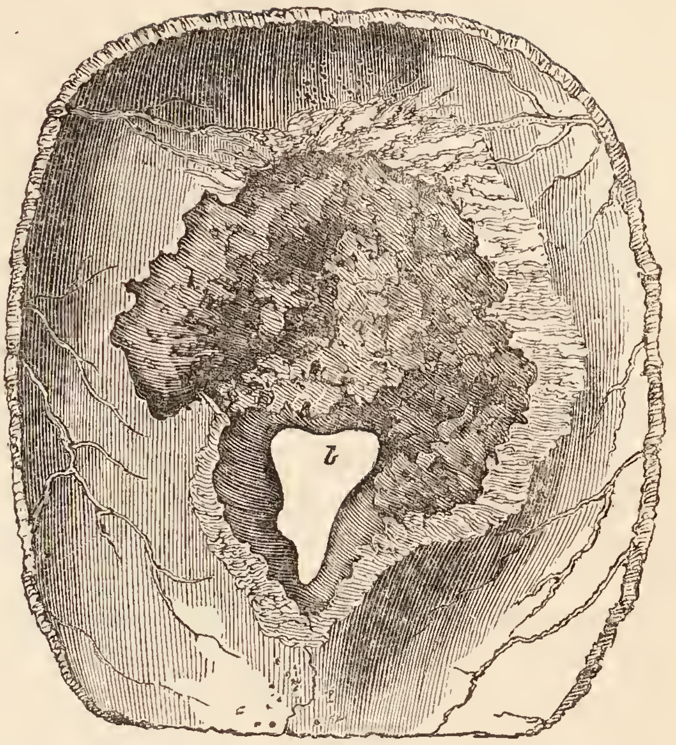

Fig. 166.—*Internal view of the cranial bones perforated by an encephaloid growth springing from the internal surface of the dura mater:* a, *bony detritus and cancerous matter adhering in part to the external surface of the dura mater;* b, *perforation. The bevelling off the substance of the cranium round the perforation is distinctly shown.*

Fig. 167.

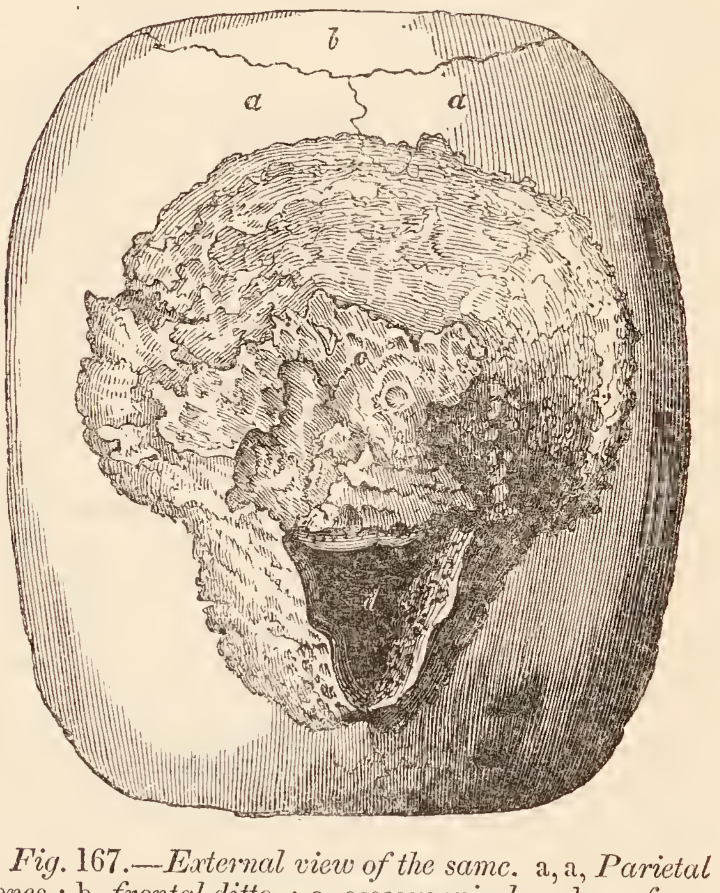

Fig. 167.—*External view of the same.* a, a, *Parietal bones;* b, *frontal ditto.;* c, *osseous spiculæ;* d, *perforation.* (*After Cruveilhier.*)

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[1] Unless as a consequence of the presence of a tumour, such lesions of the arachnoid are scarcely ever met with. M. Louis (Rech. sur le Gastro-Entérite, t. i. p. 382. 1829,) examined the brains of 500 subjects without discovering one example of cellular adhesion of that membrane.

[1] No. 133, Paris, 1816.

(*b.*) *After perforation.*—The cancerous formation having thus overcome the firmest obstacle in its way, protrudes through the adventitious foramen in the form of a fungous tumour. This tumour may possess one or more of several characters, which, if combined in any number, are pathognomonic of its nature. It presents the lobular surface, the soft elasticity and hardness of encephaloid; it is immoveable, yet non-adherent to the skin, which itself retains its natural appearance. In point of size the tumour varies exceedingly—at an early period hardly so large as a nut, it may eventually acquire, as in Grima's case (Louis), the dimensions of "a second head." When the protruding mass does not bulge out far beyond the edge of the perforation, the irregular borders of the latter may sometimes be distinctly traced. It is the seat of two kinds of pulsation—one of these synchronous with the arterial pulse; the other corresponding to the rise and fall of the brain accompanying expiration and inspiration. The tumour may be pushed within the cranium either wholly or in part, a change in its position giving rise to symptoms of cerebral compression: when left to itself it recovers its previous appearance and size. It is usually indolent under pressure, but is frequently the seat of darting pain: Louis, the Wenzels, and Boyer, suppose this produced by the sharp edge of the bone, and state that it may be relieved by *gentle* pressure.

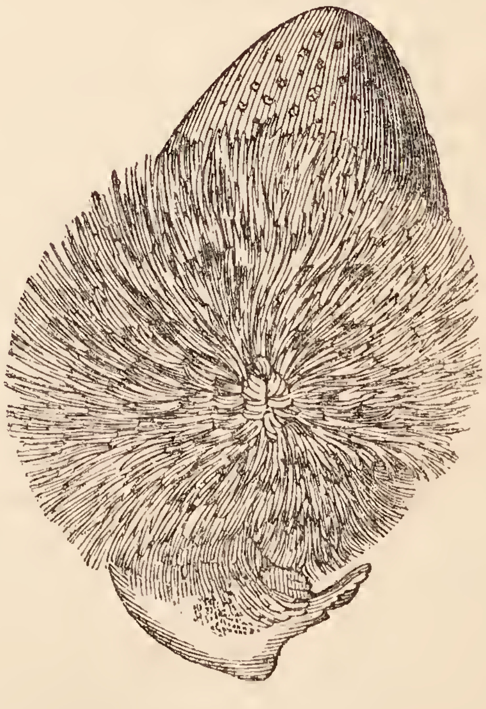
As the size of the tumour augments, the skin becomes tense, discoloured, and thin, and finally opens; the fungous growth protrudes, and the usual phenomena of such ulcers are exhibited. Death has, however, usually occurred before the disease had reached this stage. Before the protrusion of the fungus a peculiar crepitus is heard on pressing the attenuated bone covering it; this sensation is afterwards perceived within the limits of the destruction of the tables and diploe. The appearance of the tumour on the exterior of the skull is sometimes sudden, and may be accompanied, as in Robin's case (Louis), with severe symptoms—vomiting, hiccup, small pulse, and cold extremities.

But almost all these symptoms may be absent. According to Velpeau the expiratory elevation will be nearly always wanting, if the dura mater possess its natural powers of resistance, if the tumour does not protrude internally, if it traverse a thick bone, if it is not broad-based, or if it be tightly compressed between the dura mater and the integuments. Chelius' first case shows that the growth may be easily reducible and yet unaffected by the respiratory movements. Whether the arterial motion depend on transmission of the cerebral vascular pulsation or on intrinsic pulsation is undetermined; but it may be absent altogether. It must not be confounded with the individual beating of vessels ramifying on the surface. If the mass communicate with the interior of the skull by a narrow pedicle, it is irreducible: adhesions and thickening of the dura mater will sometimes produce a similar effect. Under these circumstances pressure on the tumour produces no effect on the cerebral functions: this is easily intelligible. But Espinosa reports a case from the practice of Dupuytren in which almost complete reduction of the tumour within the skull produced none of the symptoms of compression; and in Chelius's first case a similar peculiarity was noticed.

In Ebermaier's case of fungus sprouting from the substance of the *brain* the disease first presented itself externally as a painful doughy tumour, about half as large as a walnut: at a later period the protruding growth could be pushed into the cranium without producing any apoplectic symptoms; a motion distinctly corresponding to the expiratory elevation of the brain existed in the tumour. The case was attended with various symptoms of cerebral disease, and terminated fatally about a year after the occurrence of protrusion.

The following is Ebermaier's description of the course and symptoms of the disease when originating in the substance of the *cranium*. Without appreciable cause either local or general in the majority of cases, sometimes, however, in consequence of a cachexia [diathesis], at others of local injury, without pain, cerebral symptom or inflammation of any kind, a hard, accurately circumscribed, immoveable tumour, non-adherent to the skin, is developed in a variable point of the skull, causes no inconvenience for a length of time but does not yield to treatment: it has all the characters of an exostosis. The whole mass continues to grow, containing as its nucleus a sort of skeleton of osseous lamellæ prolonged into fibrous cellular tissue, between which encephaloid matter accumulates; these lamellæ sometimes produce an appearance resembling that of the sea-hedgehog, as is seen in fig. 168.

Fig. 168.



The tumour remains without change until death, circumscribed, solid, immoveable; there is no trace of osseous edge at its base—the cranial bones appear on the contrary continuous with it. Here there is no pulsatile movement; there is no aperture felt in the skull, the tumour cannot be reduced, nor does pressure on it affect the cerebral functions in the smallest degree. The disease from which this description is drawn up terminated fatally in eight months after its first appearance. Cruveilhier's case of cranial colloid was of much longer duration, and was in all probability cut short by an injudicious operation.

When the morbid production forms in the *sub-pericranial cellular tissue*, it will neither present any respiratory movement, nor give rise to cerebral symptoms when pressed on, and will of course be irreducible.

If the disease originate simultaneously in the sub-pericranial cellular tissue and on the external surface of the dura mater, the bone becomes affected by extension of the morbid change to both its tables; the diploe is last affected. When the destruction of the bone is complete, pulsation may be distinguished, as in cases of ordinary perforating fungus of the dura mater. (Chelius.)

Carcinomatous tumours presenting themselves on the surface of the skull, are liable to be mistaken for encephalocele, erectile tumours, aneurism, common encysted tumours of the scalp, abscess, and cephalhæmatoma. *Encephalocele* is accompanied with both kinds of pulsation adverted to; but, unless the result of accident, it is almost peculiar to new-born infants, and the facility of reduction, together with the relief following such reduction (unless pressure be too forcibly made), will generally distinguish it from perforating cancer. It is more frequently pedunculated than cancerous growths, and, unlike encephaloid, is of equable consistence in its entire extent.—*Erectile tumours* rarely attain any large size without affecting the condition of the skin, and their pulsation may, in general, be diminished, or even stopped, by exact pressure of the external carotid. (Espinosa, Velpeau.) Similar pressure, however, would appear to produce a like effect on protruding cancer: the pulsation of the fungus situated over the ear, observed by Orioli, was stopped by pressure on the temporal artery. Erectile tumours are more under the influence of the general circulation than fungous growths, swelling under all states of undue excitement of the heart's action; they may be, as in the remarkable case of cranial disease, figured in Cruveilhier's 33rd Fasciculus, the seat of a strong *bruit de soufflet*,—at least, when this pervades the entire arterial system.—In one of the cases related by Louis, and in Orioli's case, the affection was mistaken for an *aneurism* of the scalp; the presence of a strong bellows-sound, the absence of opening in the cranium, and the effects of pressure of the trunks of the scalp, coupled with careful investigation of the commemorative signs, will prevent this error; but we should have thought it almost impossible to avoid mistaking a perforating aneurism of the middle meningeal artery for a fungous growth, were it not that the very different and less excusable error of confounding this affection with an encysted tumour has actually been committed[1].—*Encysted tumours* are distinguished by their mobility; *abscess*, by the presence of signs of inflammatory action, and by the mode of formation of the swelling to which it gives rise.—If occurring in a new-born infant, the disease is liable to be confounded with *cephalhæmatoma;* but fungus of the surface of the skull is so extremely rare at this age, that such error is little to be apprehended. There are, we believe, but two facts mentioned by writers, which prove that perforating cancer has ever presented itself in new-born infants; one of these is the case related by Schnieber; the other the existence, in the Strasburg Museum[2], of a congenital spongy tumour, originating from the outer surface of the dura mater, and protruding through the skull.

When occurring in particular situations it seems next to impossible to avoid error as to the nature of meningeal cancer. Where the tumour forces its way into the orbit and dislocates the eye, as in cases by J. L. Petit[3], by Mr. Travers[4], and by Mr. Mackenzie[5], it assumes all the characters of orbital cancer. In Professor Bérard's case of destruction of the olfactory nerves already mentioned, and in another instance figured by Cruveilhier (Livr. viii. pl. 3.), the tumour protruded through the ethmoid bone into the nares; the similarity to a cancerous nasal polypus might easily have deceived even a practised surgeon; M. Velpeau observed a case in which the tumour first appearing at the inner canthus, soft, fluctuating, without discoloration of the skin or pain, simulated a lachrymal tumour, and afterwards an orbito-nasal cancer, depressing the eye and protruding into the nares. A similar instance is described by Louis in which the tumour made its way through the os unguis.

The curious deformities of visage produced by some of these growths are well exemplified in fig. 169.

The tumour here measured 10 inches 2 lines in length, 5 inches and 2 lines from one eye to the other, and 4 inches and 2 lines in depth, at the deepest part. The greater part of the frontal and of the nasal bones was destroyed; even the hard palate had given way, so that the tumour protruded into the buccal cavity, and obscure fluctuation was there perceptible. The patient suffered from diplopia. No autopsy was permitted: Chelius considers the case an example of coexisting disease of the pericranium, dura mater, and bones; there are several circumstances in the history, making it not improbable, we think, that it sprang from the frontal sinuses. The effects of an attempted operation on this tumour are related further on. (From Chelius.)

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[1] See Aneurism, p. 264.

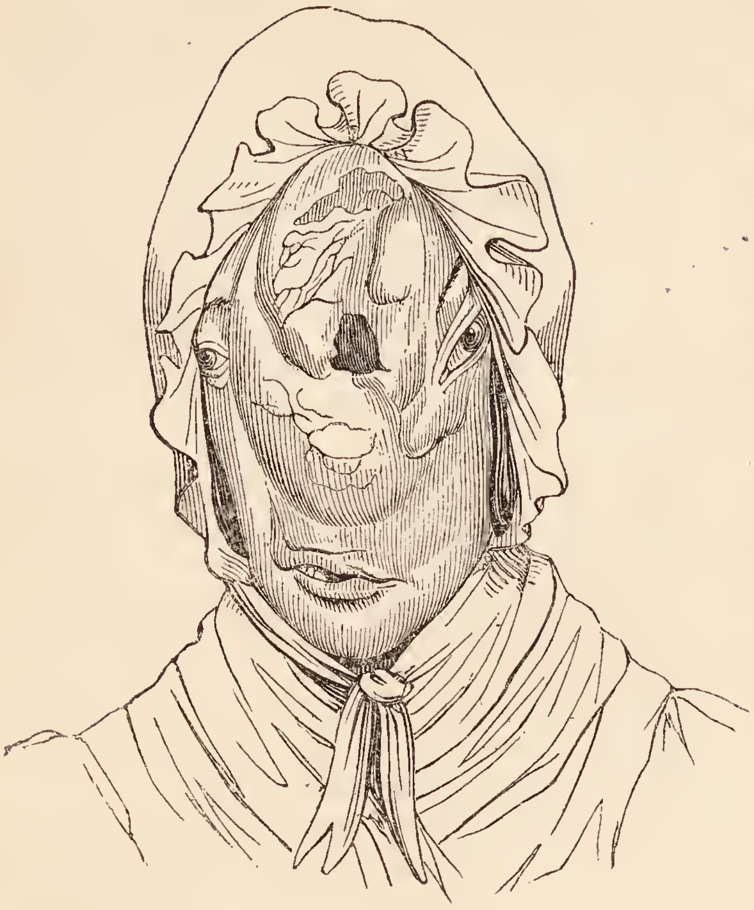
[2] Vid. Kilian, Anat. Untersuchungen über das neunte Hirnnervenpaar, s. 127. Pesth, 1822.

[3] Traité des Maladies des Os: t. ii. p. 325.

[4] Diseases of the Eye, p. 411.

[5] Diseases of the Eye, p. 80. ed. 1839.

Fig. 169.



We have already described the ordinary mode of death in cases of internal meningeal cancer; the description will, in the majority of cases, apply to the protruding species, which rarely destroys the patient with the ordinary phenomena of external cancinomatous disease. A table is given further on which shows, that in twenty-one at least of the cases on record, the cerebral symptoms preceding death were brought on by various operations, or attempts at operations, on the tumours. According to Velpeau, when these patients perish rapidly, the dura mater or surface of the brain is found inflamed, covered with pus, ulcerated, softened, or reduced to a putrid detritus; in other cases there is purulent infiltration of the arachnoid, extending to the occipital foramen, with apoplectic effusion into the brain. Among sixty cases Velpeau only detected three in which there was coexisting cancer in other organs.

The duration of the disease differs extremely in different instances. Graff's patient had suffered thirty-seven years at the time of her death; Louis speaks of a case which lasted forty years; others have been known to exist for thirty, fifteen, and ten: but its ordinary course is much more rapid. The slow course of the disease in the cases referred to, may, on first view, appear an argument against its cancerous nature, but Graff's narrative is precisely one of those which, by their precision and minuteness, place the encephaloid character of the malady beyond the reach of controversy.

The seat of these cancers, in respect of the region of the skull affected, was as follows, in 51 cases analyzed by Velpeau:

13 in the parietal region,
8 — temporal —
7 — frontal —
7 — orbito-nasal—
7 in the occipital region
5 — vertical —
3 on the petrous bone,
1 in the substance of the falx cerebri.

Tumours of the *internal* surface of the dura mater, in particular, have been most frequently met with by Cruveilhier at the angle of union of the falx cerebri with the rest of the membrane, when seated at the convexity of the skull; in the olfactory groves, the sella turcica and the surfaces of the petrous process, when occupying the base.

The *number* of tumours existing in one skull varies. It appears from M. Velpeau's inquiries that they are commonly single, as had been already affirmed by Meckel; twelve examples only of multiple development presented themselves in sixty cases. They are sometimes very numerous; Sandifort found eighteen, Ritterich fourteen in one subject, and cases almost similar have been observed by others. Cruveilhier[1] speaks of having discovered one hundred in the diploe of a subject with mammary cancer.

Of the causes of the disease nothing is known: numerous writers gratify their fondness for universal explanation by ascribing it to blows; but they fail to adduce a particle of evidence proving that the disease had not existed before the receipt of the injury; this appears, however, in some cases, to have hastened the occurrence of protrusion. Abernethy, true to his general doctrine, conjectures that an effusion of blood from a blow might become organized, and form a fungus; but he had not himself observed any facts in support of such a view[2]. Were this notion established, the influence of external injury would be clearly defined. (See Hæmatoma.) Some attribute the affection to the venereal cachexia; others (such as V. Walther, who looks on it as identical with the white swellings of joints,) to the scrofulous: both opinions, merely hypothetical at the best, are disproved by observation.—The affection has been met with in the two sexes with about equal frequency; twenty-three of the subjects of forty-four cases, collected from different sources by Velpeau, were males, twenty-one females. It is observed at every age, as the following table of forty cases, by the same writer, fully shows:

From æt.	0	to	10	6	cases,
—	20	—	30	7	—
—	30	—	40	10	—
—	40	—	50	9	—
—	50	—	60	5	—
—	60	—	80	3	—

Treatment.—Upon the inutility of resolvents, and local applications of all kinds, it is unnecessary to dwell.

Compression originally, as we believe, employed from the disease being mistaken for encephalocele, and apparently warranted by the result of a curious case related by Louis (the benefit derived really depending on the reduction of the tumour), is justly rejected wholly by modern practitioners.

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[1] Livrais. xx. Os. p. 4.

[1] Surg. Observ. on Injur. of the Head, p. 58. Ed. 1826.

The destruction of the tumour has been attempted in many instances by opening it with caustic. Five out of six cases treated in this way, and collected by Ebermaier, terminated fatally, almost immediately: in the case with successful issue, related by Eck, doubts are thrown out by Velpeau, whether the disease was really cancerous.

Ficker describes an example of apparently successful ligature; Velpeau questions the carcinomatous nature of the disease in this instance also. In other cases constriction with a ligature has been followed by convulsions; Mr. S. Cooper mentions his having observed the fatal effects of this mode of operation exemplified at St. Bartholomew's.

In order to place, in the very strongest light, the disastrous consequences to be expected from merely incising these tumours, or from a partial attempt at their removal, we subjoin the results of a number of instances in which such measures were had recourse to.

REFERENCE.	OPERATION.	RESULT.
Amatus Lusitanus. (Centur. 5. Obs. 8.)	Incision.	Death in convulsions, 2 days after.
Camerarius.	Opening with caustic.	Death on 3rd day.
Ambroise Pare. (Louis, p. 10.)	Opened for an abscess by a barber.	Death on 2nd day.
Petit. (Louis, p. 13.)	Opening with caustic potass.	Death a few days after.
Sivert. (Louis, p. 14.)	Incision.	Draining hæmorrhage, death on 2nd day.
Rey. (Louis, p. 21.)	Tumour incised crucially.	Stupor after operation, continuing until death, on 5th day.
Legrand. (Louis, p. 23.)	Caustic applied.	Convulsions and death on 8th day.
Choppart. (Louis, p. 31.)	Central incision.	Death in less than 24 hours, without convulsions or pain. (Infant, æt. 2.)
Saltzmann. (Louis, p. 34.)	Partial removal of tumour.	Death on 11th day.
Volprecht. (Louis, p. 36.)	Incision of skin & pericranium; one-third of the bony circle, but none of the morbid growth removed.	Lingering death, with cerebral symptoms.
Philippe. (Louis, p. 43.)	Tumour incised.	Death a few (6 or 8) hours after; slight delirium and convulsions.
Heister. (In Kaufmann.)	Opened with caustic.	Hæmorrhage, — convulsions, — death in about 24 hours.
V. Walther.	Incision of base, hæmorrhage, & ligature of 10 arteries; 2 lbs. of blood lost.	Cicatrization; patient alive two years after; the tumour only slightly enlarged.
Siebold.	Attempted removal.	Death under knife, from hæmorrhage and convulsions.
Siebold.	Incision from one end to the other of the tumour.	Death on the 4th day.
Astley Cooper.	Tumour partially removed.	Fever; coma on the 4th, death on the 6th day.
Klein.	Tumour punctured with a trocar, and 4 ounces of blood drawn off; then incised in its entire length.	Death on the 4th day.
Schnieber.	New-born infant: tumour removed by the father with a razor, as close as possible to the base.	Gradually reappeared without affecting the child's health.
	Again removed to the level of the bone; the patient ætat. 5.	The fungus reappeared, and was as large as before on the 11th day: death on the 15th.
Graff.	Removal to level of skull.	Patient lived 6½ months, when the tumour had re-acquired its original size.
Wishart.	Crucial opening made.	Fungous growth sprouted out in 3 days; death on the 14th.
Travers.	Tumour incised for an abscess.	Free hæmorrhage; "death quickly followed."
Chelius. Case 4. (vide fig. 169.)	On first incision, tremendous hæmorrhage; a large part excised; obstinate bleeding (April 1826).	Wound almost closed 6 weeks after; but tumour then larger than before operation; pulsatile, painful, and the seat of frequent hæmorrhage.— Death December, 1827.
Amussat. (Cruveilhier's case of cranial colloid.)	Partial extirpation.	Reproduction;—death in one year.
Jobert.	Removal to level of skull; actual cautery applied to the bone.	Disease returned in a month. (Case afterwards operated on by Bérard, jun.)
Orioli.	Imperfect removal.	Rest removed by gangrene: recovery.

There can be little question in the mind of any one, after a perusal of these columns, as to the fitness or unfitness of incising, applying caustic to, or partially removing these tumours. If any operation be admissible it is evidently the complete ablation, and this only, of the diseased growth. And if we look to past experience for facts justifying such extirpation, we shall find few to encourage us in pursuing or recommending the practice, or to authorize the surgeon in regarding the affection otherwise than with Ebermaier, as a *noli me tangere*. The successful issue in the cases of Severinus and Wepfer must be looked on as a fortunate chance; of the only two operations, as we believe, performed of late years—those by Bérard and Orioli—the latter, it is true, terminated successfully, the other fatally in 34 hours. The operation, however, can neither claim the honour of the recovery in the one case, for this was the accidental effect of gangrene attacking a portion of the tumour which the operator had been unable to reach; nor can the propriety of operating in general be denied on the score of the disastrous issue of the latter, for from the size of the tumour—sixteen applications of the trepan, an interval of one or two lines being left between each pair of circles besides, were required—the case was unusually unfavourable for operation. As to the opinions of writers on the point, we find Boyer recommending extirpation in but a very few cases; Delpech rejecting it altogether; Richerand advising it only when the growth is seated at the upper part of the head; Velpeau confining it to tumours with a narrow base and which only require removal of the bone without implication of the dura mater. There can be no doubt of the theoretical propriety of the last opinion, and in the instances of sub-pericranial and cranial cancer it may be carried out in practice, as it is not impossible to distinguish these from the more deeply seated forms. But we have already stated that there is no diagnostic mark whereby fungous protrusions growing from the internal surface of the dura mater or deeper parts may be distinguished from those springing from the external surface of the former texture. If, however, upon removing the surrounding bone the operator should discover that the deep surface of the dura, or even the pia mater were involved, Cruveilhier and Velpeau both agree in the propriety of removing these membranes; in fact, where the operation has advanced so far, there seems no other course left to be adopted.

If the operation be determined on, the investing skin should be divided by a conical incision and the flaps dissected back sufficiently far to allow of the application of the trephine round the tumour. If there be any unsound skin, this should be carefully removed; but it is important that as much as possible be retained for covering the exposed dura mater or brain. For a particular description of the steps of the operation we must refer to the articles Head, Trephine. Bérard performed his operation on two successive days: on the first occasion three quarters of an hour were occupied in applying the trepan six times; on the second, an hour and a half in the remaining ten applications. This mode of dividing the operation might be imitated where the growth is very large; but such dimensions undoubtedly form a special contra-indication to its performance. The extensive exposure of meningeal surface is one of the most serious obstacles to success: a writer in the *Gazette Médicale*, commenting on this, enquires whether it might not be remedied by autoplasty. A remarkable circumstance attending Bérard's operation was, that on the removal of the mass, the ordinary symptoms of *compression* of the brain came on; the patient was restored to consciousness by firm pressure on the part of the hemisphere corresponding to the seat of the fungus. This physiological fact may be usefully compared with Magendie's experiments on the cephalo-rachidian fluid.

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(B.) *Spinal Meninges.*—Cancerous disease of the spinal canal may originate precisely in the same situations as in the skull; but the disease is rare, and of its protrusion externally there have been but few examples preserved by the industry of writers.

Philipps relates the case of a youth aged 14, who fell from a second story window into the street, whereby his back was bruised, but no fracture caused. The sufferer was able to walk with his body bent forward. Three years and a half after the accident he was seized with violent pain in the back, thighs, and legs, and a tumour began to form over the lumbar vetebræ, which increased to a great size; it was red on the surface, and the source of frequent hæmorrhage. Complete paraplegia, incontinence of urine and fæces, &c. supervened, and the patient died six years after the fall. The tumour consisted of encephaloid, took its origin from the spinal cord, and had spread upwards, as also downwards, extending from the third dorsal vertebra to the coccyx. Several dorsal and lumbar vertebræ were "carious," and some of the latter had altogether disappeared: there was general softening of all the bones of the spine, of the sacrum, and the ileum.

In a case of similar character related by Wolff, the tumour formed at the upper part of the back; the patient had also had a fall, and there was paraplegia and incontinence of urine. Pressure on the swelling caused vertigo and a disagreeable sensation in the front of the head. [Could this have arisen from the forcible repulsion of the cephalo-rachidian fluid into the ventricles?] A second tumour soon appeared in the lumbar region. On post-mortem examination the new growths were ascertained to possess the chemical and physical constitution of encephaloid; they adhered to the medulla, which was scarcely softer than natural, though its "investments were destroyed in the corresponding places." The spinous processes of eight vertebræ had totally disappeared.

We owe to Lecat the record of a case in which partial excision was performed. G. I. shoemaker, received, in 1750, a violent blow in the loins, after which a "carcinomatous tumour" formed there; the disease destroyed the spinous processes of the four first lumbar vertebræ, and part of the sheath of the medulla. "All these nervous parts [encephaloid matter], dilated into mushroom-like growths, formed the tumour." It was extirpated in 1751 without loss of blood, but "such a prodigious *nervo-lymphatic* discharge followed from the medulla that the thickest cloths were saturated." The patient died of exhaustion in two days.

For the incipient symptoms of the disease we must refer the reader to the medical works below enumerated.

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VIII.—*Alimentary Canal.*

(A.) LIPS.—Labial cancer may commence by infiltration of scirrhus, presenting the characteristic properties of this formation, in a limited extent of the lip and apparently underneath the skin at the junction of that membrane with the mucous surface[1]. After a variable length of time, the skin, or more commonly the mucous tissue, gives way, the resulting fissure discharges a thin acrid fluid; this dries and forms a scab, which falls off or is torn away accidentally and is reproduced. Meanwhile the ulcerative process advances, at first slowly; the formation of regular scabs ceases, and fungous formations spring from the scirrhous basis. These are of the hard species; and we have not met with any instance in which encephaloid matter is alleged to have been produced in this situation. In some cases the production of a cutaneous warty excrescence, such as has been elsewhere descibed, is the first phenomenon observed: this is not unfrequently tinged with melanic matter. Mr. Warren observes that the cuticular crust continues to be regenerated for years in some subjects, before any thickening of the skin is perceptible; in such cases the affection is not originally cancerous. The same surgeon describes an example of the disease which commenced "by a pustule which after bursting left a scab." As the disease advances, the skin, mucous membrane, and labial glands form a prominent mass, which combined with the fungous productions from the sore, produce an abundant slaver that constantly escapes over the edge of the lip, and irritates and excoriates the adjoining skin. The ulceration may spread over the entire cheek and destroy even part of the external ear; or the morbid formation extend to the maxilla, as in a case observed by Mr. Travers, where an immoveable scirrhous tumour extended from this bone to the os hyoides, went through its stages with rapidity, and finally choked the patient while in the act of swallowing. The destruction has been known to extend even to the sternum. It was remarked by Bayle, and the observation has been confirmed by others, that so long as the ulcer implicates the skin only, it remains comparatively superficial, but when the mucous membrane is attacked, excavates deeply, destroying all the tissues of the part: this, of course, refers to cases wherein ulceration commences distinctly by the cutaneous surface. The salivary and the lymphatic glands become enlarged and painful; the latter especially may be infiltrated with scirrhus. General contamination of the system is comparatively rare; a remarkable instance of its occurrence, wherein the heart was the seat of numerous cancers, has been related by Mr. Coates[1].

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[1] Pearson, Travers.

Labial cancer, rather frequent among males, is singularly rare in the other sex. It almost invariably affects the lower lip, and seems not uncommonly to acknowledge as an exciting cause, the irritation of a pipe or tobacco-juice. But the inadequacy of this to produce the disease in a non-predisposed subject appears from the consideration, as Mr. Travers excellently well observes, that "of the number of smokers the proportion of persons so affected does not exceed that of cancerous to sound persons." Rough and prominent edges of teeth act in a similar way.

When the cancerous nature of the disease is established, no time should be lost in removing it. Destruction with caustic has had its advocates, and may be had recourse to in the case of timorous patients, but the knife is greatly preferable. The indurated mass may be removed by two straight converging incisions meeting inferiorly at a point: a triangular portion of tissue is thus cut away, precisely as in the hare-lip operation; the exposed edges are then brought together by the twisted suture. If, however, the disease occupy a large share of the lip, this mode of removal is inapplicable; and a semi-circular or crescentic section must be substituted for it. Mr. Travers, who has made trial of this plan, mentions the disuse of sutures as one of its principal advantages, and states that in a case where the removal extended to the frænum, the natural appearance of the part was eventually in a great measure restored—"the cut surface takes a depth of colour, a plumpness, and a defined border, which has much the appearance of the natural surface." M. Bégin, arguing upon the contraction of the lip which follows the triangular excision, and the disfiguring protrusion of the sound lip entailed thereby, seems to consider that it should be abandoned altogether in favour of the crescentic operation; it is true, he admits, that the gradual elongation of the divided substance removes the deformity referred to to a certain extent, but the traction exercised on the labial tissue during this process may, he conceives, contribute to the reproduction of the disease. Dupuytren, likewise an advocate for the semicircular section, performed it with a pair of strong curved flat scissors; a bistoury is more commonly employed. The wound should be covered with a little moistened lint kept *in situ* by a double-headed bandage passing over the vertex and occiput. The saliva escapes at first abundantly from the mouth, but the reparative efforts of nature usually remove this serious inconvenience: should this not be the case, a silver lip may be adapted to the part; or the lost tissues, as recommended by Mr. Earle, restored by cheiloplasty. The angles of the mouth should be spared, if this can be safely done.

The position of the disease sometimes requires an *impromptu* modification of the ordinary modes of operating. In a case of cancer occupying the right half of the upper lip, and extending to beneath the left ala of the nose, M. A. Bérard removed the mass by two straight parallel incisions perpendicular to the lip and united by a transverse one at the base. Two lateral flaps were then formed by prolonging the transverse incision to the border of each masseter, and by slitting up the cheek from the commissure of the lips to the same point. Each flap, of rectangular shape, had three of its borders free; having been drawn towards each other, the inner edges of these were next united by the twisted suture; the upper similarly fixed to the cheeks and lower part of the nares, and the inferior united in the same way, as far as the commissures of the mouth; part of the inferior cut edge formed the free border of the new lip. The wounds cicatrized by first intention, and the new lip subsequently assumed the appearance of a natural one on which the hare-lip operation had been successfully performed[1].

(B.) GUMS.—See MAXILLA.

(C.) TONGUE.—Lingual cancer, which, as far as we have been able to ascertain, is almost invariably of the scirrhous species, commences—1, As a small distinctly circumscribed but somewhat knotted tumour, generally seated in the anterior part of the organ midway between the raphe and one edge, and rarely extending beyond the middle line; 2, or as a small excrescence, which eventually in some instances becomes pedunculated; 3, or cancerous deposition in rare cases complicates simple ulceration, produced, for example, by the contact of a carious tooth: 4, or, in still rarer instances, erectile tumours become the seat of such deposition.

In either case the surface ulcerates (the mass may have acquired such size as to extrude the tongue from the mouth before this change occurs) and presents the usual phenomena and appearance of carcinomatous ulcers, the fungous formations sometimes assuming the cauliflower shape and attaining large dimensions. The progress of the disease is in some cases extremely rapid: Mr. Warren records an instance in which eleven weeks sufficed to change a "small hard lump on the edge of the tongue into an extensive ulcerated fungus, rising a quarter of an inch above its surface, and covering half its breadth." The ulceration may spread to the buccal and gingival mucous membrane, while the non-ulcerated part becomes covered with warty vegetations. The sublingual and submaxillary lymphatic glands undergo the ordinary changes: Mr. Travers has known them form the base of the tumour, while a cauliflower fungus occupied half the tongue and covered the lower jaw.

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[1] Med. Gaz. vol. xviii. p. 575. 1834.

[1] Gaz. Méd. de Paris, p. 541. 1835.

Acute pain is not a constant symptom; there is generally an aching sensation experienced, varied occasionally by sharp pangs darting in the direction of the ear. The necessity for constant sputation forms one of the most distressing concomitants of the disease: and at night the accumulation of the discharge interferes with the patient's rest by exciting cough. The secreted matters are swallowed in large quantities, and according to Bégin sometimes glide into the respiratory passages; this surgeon attributes the constitutional suffering in some measure to such deglutition. The mechanical action of the growth, particularly when it attains large size, produces pain and difficulty in articulation and in the mastication and deglutition of food, gradually increasing until the performance of these functions becomes an impossibility. As an evil of a minor kind, the jaws are often unconsciously closed on the enlarged organ, which is very painfully compressed. The cachexia is sometimes exhibited in an intense degree.

Mr. Travers fixes upon strong and healthy males of the age of 40 and upwards as the most usual subjects of lingual cancer; the disease is, however, observed not unfrequently in the other sex, and in much younger individuals.

Cancerous disease of this organ is liable to be confounded with some other affections. Mr. Travers describes a *globular tumour* seated deeply in its substance, very uniform and unyielding on the surface, and like a marble in point of size, and to the feel. He has invariably found this tumour disappear under the use of alkalies and tonics. Having never opened it, or examined its structure, he is only enabled to presume it to be a cyst containing an albuminous fluid. *Syphilitic ulceration*, accompanied with induration, so strongly resembles the scirrhous species, that it is occasionally next to impossible to distinguish them. The former is, according to Bégin, of greater extent; the induration more diffused, furrowed with deep fissures, and furnishing scarcely any discharge, The action of mercury is far from a test of the nature of the sore, as this mineral is sometimes decidedly injurious where no question can be entertained of the really syphilitic nature of the ulcer. Lingual syphilitic sores are almost always secondary, but sometimes *primary*, as is proved by the results of inoculation. *Simple ulceration* generally depending upon the irritation of accumulated tartar or of a carious or prominent tooth, is usually to be distinguished by the rapid cure which follows the removal of the irritating agent. *Erectile tumours*[1] of the surface of the tongue are to be known by the peculiar characters of that tissue: their liability to become the seat of cancerous deposit should not be forgotten. Mr. Warren describes an *enlargement of the mucous glands*, commonly occurring on the side of the tongue, with a red fungous appearance, but differing from cancer by its being "sensitive, not painful, and unattended with real ulceration or thickening of the tongue." The diagnostic marks of some other affections will be stated in the article Tongue.

The necessity of operating at an early period cannot be too strongly insisted on, especially on account of the greatly increased difficulty of removal when the disease extends deeply towards the base of the organ. Mr. Travers has only known one case operated on at an advanced stage in which a relapse did not occur within a twelvemonth. The morbid growth may be removed by ligature or excision.

The former plan ensures us from the danger of the serious hæmorrhage which sometimes results from division of the ranine, &c. arteries. A curved needle, armed with a double ligature, is passed through the tongue and opposite the central part of the diseased mass; the ligatures are then tightly tied, one in front, the other behind, so as to embrace both divisions of the cancer. This manœuvre is difficult of execution when the disease extends far back, as the posterior ligature can hardly be pushed far enough back to circumscribe it. M. Bégin, too, urges the vast tumefaction, the accumulation of putrid sanies, the pain, the difficulty of breathing, and other serious symptoms which almost inevitably follow this operation, as reasons for rejecting it altogether; he alludes to a case in which it proved fatal in a Parisian Hospital, from the violence of these symptoms.

When about to excise the diseased mass, the surgeon, as a preliminary step, places small cork or wooden wedges between the teeth, to prevent the approximation of the jaws. If the cancer be seated towards the point or at the edge of the organ, it may be seized with the thumb and fore-finger of the left hand, previously covered with linen, and a straight bistoury being passed behind the diseased portion, the whole removed at a single stroke. In some cases the mass is so situated that a piece of triangular shape requires to be removed. Under such circumstances Boyer and Langenbeck recommend the edges of the hiatus to be brought together by suture anteriorly, with a view to prevent hæmorrhage and lessen subsequent deformity. Bégin, however, denies the advantage of the suture in the latter respect, as the tissue of the tongue becomes elongated, and repairs the losses it may have sustained with extraordinary facility. When the disease extends far back, an assistant is required to keep the tongue steadily out of the mouth. The fingers and a piece of linen are usually sufficient for the purpose; where they fail, a pair of forceps with blades terminating in hooked extremities (velsellum) may be used to seize the diseased mass, or if particular difficulty arise in any instance, a ligature passed through that part. The surgeon then transfixes the tongue with a straight bistoury behind and without the disease, and bringing it forwards to the apex, separates the healthy tissues laterally; the posterior separation is next effected by carrying the bistoury outwards from the posterior point of the incision to the edge of the tongue. No dressing is required. Serious hæmorrhage, as we have said, sometimes follows. Ligature or torsion of vessels is rarely efficacious in checking it, as the blood flows from a multitude of points on the divided surfaces; ordinary astringent gargles frequently fail, and we have seen cases in which the actual cautery was required to stop the effusion. Where this is necessary, pieces of pasteboard should be placed in the mouth for the protection of the surrounding parts. If the bleeding continue in spite of all other measures, the lingual artery should be taken up above the great cornu of the os hyoides[1]. Flaubert, of Lyons, tied the vessel as a preliminary measure.

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[1] Brown; Lancet, March 30, 1833.

Should the disease encroach on the base of the tongue, the application of a ligature in the ordinary way is, as has been stated, far from easy and may be impracticable. Under these circumstances the complaint had been considered beyond the reach of surgical interference, until the bold performances of Jules Cloquet, Mirault[2], and Mr. Arnott[3], proved that a ligature might be safely applied from beneath the jaw. See TONGUE.

(D.) TONSILS.—Hypertrophous induration of the tonsils is a condition of most common occurrence, while the deposition of true scirrhus in these glands is exceedingly rare. Their removal is strongly indicated if, resisting ordinary treatment, they continue to increase in size; for if they really be the seat of cancerous infiltration, this may extend backwards into the pharynx beyond the easy reach of instruments. The modes of excising or applying a ligature to these bodies (the former is the better operation according to the testimony of most practical surgeons, although it is accompanied with the risk of severe hæmorrhage) are described in the article TONSILS.

We have never observed encephaloid tumour or infiltration of these glands, and believe that the following description by Dr. Carswell is almost unique. In speaking of cancer of the lymphatic system we have referred to the subject furnishing these very remarkable appearances. "The amygdalæ, formed entirely of cerebriform matter, presented a pale yellow colour tinged here and there with red specks, produced apparently from the rupture of minute blood-vessels. They had also lost that characteristic appearance from which they derive their name, having become almost perfectly smooth, from the accumulation of the cerebriform matter and the distension of their envelope."

(E.) PHARYNX.—Scirrhus of the infiltrated form is the species of cancer most commonly observed in the pharynx; cerebriform growths, except in the shape of fungating masses, from an ulcerated basis, have been more rarely met with in this situation. Carcinoma of the pharynx is under all circumstances an uncommon disease. When first examined it usually presents itself as a hard imperfectly circumscribed mass, occupying a variable extent of the submucous tissue of the canal, and invested by the mucous membrane, which in the early stages retains to all appearance its normal characters. The swelling or tumour—for, from the abundance of infiltration, distinct and irregularly rounded elevation is produced—may be pressed, unless its mucous surface be accidentally inflamed, without exciting pain. Eventually the surface ulcerates and the opening presents the characters elsewhere assigned to cancerous ulceration, gives rise to the same hæmorrhage and fœtid discharge, while fungating growths, with the tendency to the pyriform and cauliflower-shape, sprout from its edges or centre. The diseased mass is now tender to the touch. The destructive process spreads in different directions: in a case we had an opportunity of observing at the Hôtel-Dieu in 1835, the base of the tongue, the velum palati, and part of the epiglottis were destroyed; in other instances the œsophagus, the posterior region of the nares, &c. suffer. The cervical glands undergo the changes observed in cancerous disease.

It would appear that the morbid matter in many cases accumulates to some amount before it excites any very distinct symptom; a sensation of fullness in the affected region, and trifling difficulty in swallowing, have often existed for some time before they become sufficiently troublesome to alarm the patient. But the supervention of pain at length rouses his apprehensions, and the pharynx, examined at this period, generally presents the incipient changes above described. The dysphagia increases, the ingesta, both solid and liquid, frequently return through the nostrils in the efforts to swallow, and deglutition at length becomes impossible without the aid of instruments. Before this, ulceration has usually set in, and the discharge from the sore is rejected from time to time with a painful effort, evidently distinct from that of vomiting. Part of the sanies, however, is swallowed, or gravitates into the stomach, where its presence excites nausea, and sometimes, it is said, a burning sensation. The extension of the disease to the larynx is announced by a change in the voice, which rarely, however, terminates in complete aphonia. The posterior nares are sometimes obstructed with fungating productions; in this case, according to the remark of

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[1] See Fig. 85, No. 3. p. 263.

[2] Dict. de Méd. 2ème éd. t. xvii. p. 497.

[3] Med. Chir. Trans. vol. xxii. p. 20. 1839.

Bayle, there is dyspnœa. Sir C. Bell and Mr. Travers speak of "difficult breathing, frequent spasms and alarms of suffocation," as constituting part of the symptoms; under these circumstances the air-passages must be obstructed, either directly or indirectly, by the volume of the mass in the pharynx. Here, as in other regions, hæmorrhage may be the very first symptom noticed. In the case we observed at the Hôtel-Dieu, a profuse discharge of blood took place, before any pain or difficulty in deglutition had been experienced—a fact placed beyond all doubt by the uniformity of the patient's replies under repeated questioning. The effusion of blood frequently recurred and finally proved the cause of death: an opening of small size was discovered in the internal maxillary artery. The ordinary mode of death in cases of pharyngeal cancer is however by inanition; the sufferer falls into the last stage of marasmus, and exhibits with its usual characters the cancerous facies and discoloured skin. The disease may prove fatal by extending to the larynx, as in a case related by Sir C. Bell[1].

Simple hypertrophy of the walls of the pharynx is so rare an affection, that we have not been able to find a sufficient number of cases for the purpose of ascertaining the points by which it is distinguished from carcinomatous infiltration; yet the importance of the distinction for the surgeon's reputation is obvious. Simple induration, with thickening of the submucous tunic, will entail the same dysphagia as cancer, and, as we have had an opportunity of observing, lead to the rejection of the food through the nares. The effects of treatment and the ulterior progress of the disease should be watched for a time, before a decisive opinion is ventured upon.—*Hernia* of the mucous, through the fibres of the muscular coat[2], is accompanied with difficulty of deglutition and is only to be distinguished by most careful examination.—See Pharynx. The distinction of certain *venereal and scrofulous sores* from cancerous ulceration is to be established by the commemorative symptoms, the constitution of the subject, the state of other organs, and generally by the effects of treatment. Inoculation will not settle the question of the syphilitic or cancerous nature of a pharyngeal sore; for venereal ulcers are in this situation secondary, and the matter of such surfaces does not, as M. Ricord has shown, produce chancre by inoculation.

In the treatment of cancer of the pharynx the surgeon is almost completely restricted to palliative measures. Pain may be relieved by emollient and narcotic gargles; the fetor and nauseous character of the discharge lessened by the use of the chlorides in the same way. The obstruction to deglutition is sometimes so considerable, and this for a length of time before death, that the use of the œsophagus-tube is required. But whatever delicacy and gentleness be observed in the introduction of this instrument, its repeated passage causes much irritation; this is in some instances so violent and accompanied with such copious hæmorrhage, that persisting in its use would only hasten the unfortunate sufferer's end: in cases of this kind the tube may be left permanently in the canal; in this way its presence is not productive in *some* subjects of nearly so much irritation. Nutritious enemata and baths are indicated as a last resource. Hæmorrhage may be restrained by astringent gargles.

Bégin and writers of the Broussaisian school of course recommend the direct application of leeches to the diseased part: chronic inflammatory induration may be thus removed, but there is no proof to be found of their *curative* efficacy in carcinoma of this region. Cauterization has been tried, but not with results warranting much confidence in this mode of treatment.

Excision has, so far as we have been able to ascertain, been very rarely attempted. Independently of the general objections to the operation, the difficulty of making out the exact boundaries of the diseased formation, and of removing every particle of that which is discovered, must interfere very seriously with its probable success: nor should it be forgotten that, as Mr. Warren remarks, "a hæmorrhage might present itself from the deep parts involved, which no art could suppress." The steps of the operation—should a case present itself in which the use of the knife seemed practicable—must vary according to the precise part affected; the surgeon should be prepared to meet all difficulties and accidents, which it is possible to anticipate.

(f.) Œsophagus.—Cancer of the œsophagus occurs most frequently at the upper end of the canal behind the larynx, most rarely at its middle part, and may, as in a case figured by Baillie, occupy nearly its entire length and circumference. Infiltrated scirrhus deposited in a stratiform manner, encircling the walls of the tube more or less completely, and causing gradual diminution of its calibre, is the most common condition in which the disease presents itself. Distinct scirrhous tumours are comparatively very uncommon; tuberiform encephaloid still more so.

The formation of cancerous matter in this region is, according to Bayle, commonly preceded by pyrosis, hiccup, and transient pain in the fauces: it is certain, however, that suddenly developed dysphagia is frequently the first sign of its existence. The *nature* of the symptoms of œsophageal cancer is the same as when the disease is seated in the pharynx, but as the contraction is seated lower down, the first stages of deglutition are accomplished naturally. Subsequently, if the coarctation affect the upper end of the canal, the greater part of each mouthful of food at once regurgitates: if a lower part, three or four mouthfuls pass with facility, and the accumulated matter is then gently expelled by the action of the muscular fibres. These occurrences are at first only occasional—a circumstance which tends in some cases to keep alive the hope that the patient suffers from spasmodic stricture only. But the dysphagia eventually becomes permanent, and the obstruction increases to such a degree that not a particle of solid or even liquid food reaches the stomach. Sometimes a dilated pouch forms above the obstruction—here the food accumulates, and is rejected with laborious effort after a variable lapse of time. The ingesta are under these circumstances usually mixed with glairy mucous matter, which is, according to Bayle, never tinged with brownish fluid, and is thus distinguishable from the substances vomited in cancerous disease of the stomach. In a remarkable case related by Mr. Purton[1] exemplifying this condition, the patient, a man aged 43, had for twenty years been subject to attacks, lasting three weeks or more at a time, during which no food directly reached the stomach. Post-mortem examination disclosed a huge pouch extending from two inches below the pharynx to the cardia, and containing two measured quarts of grumous matter and fluid: the cardia was pervious but much contracted. This person had been in the habit of allowing the ingesta to accumulate in the sac for hours or even days; when it was completely filled, he made efforts at swallowing, by which the contents were forced on to the stomach. For the last six weeks of his life he was reduced to the support of nutritious injections.

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[1] Surg. Obs. vol. i. p. 53.

[2] Ludlow in Med. Obs. and Inq. vol. iii.; and C. Bell, loc. cit. p. 66.

The progress of the disease is accompanied with pain, the seat of which indicates, in some rare cases, with much precision, that of the morbid formation. In others the suffering is referred to the entire length of the canal, or is felt in the back, in the shoulders, or in the arms. The extension of the pain in this manner is by Bayle supposed to depend on the formation of adhesions between the cancer and the adjacent parts. Deglutition is frequently accompanied with pain shooting along the fauces to the base of the skull and through the eustachian tube to the ear.

Patients afflicted with cancer of the œsophagus usually perish, as those whose pharynx is similarly diseased, by inanition: the cachexia is commonly well established. They are exposed to the chances of severe hæmorrhage. Perforation of the diseased tube, with effusion of the ingesta into the mediastinum, determining an abscess in that region; the establishment of a communication between the œsophagus and the trachea, bronchi, pleura, or pulmonary tissue, not very unfrequently shorten the patient's days. Yet the existence of such communication with the lung is not incompatible with the continuance of life: M. Moutard-Martin[2] has published a singular case wherein a large cavity, formed in the lung (though partly empty it contained six ounces of whitish-gray grumous matter) communicated freely with the œsophagus; the food, entering into it with facility, regularly accumulated in this adventitious stomach.

Among the diseases simulating carcinomatous contraction is *spasmodic stricture*, an exceedingly rare affection, but one capable of temporarily obstructing deglutition quite as completely. The sudden occurrence of the complaint, its induction by moral causes or by adjacent irritation, its almost constant accompaniment by nervous symptoms, and the success of antispasmodic and dilating treatment sufficiently characterize this species of dysphagia; sudden supervention of the symptoms is not, however, conclusive of the spasmodic nature of the affection. Chronic inflammation leading to *hypertrophy* and *induration* of the walls of the œsophagus is an affection of much less common occurrence than has been supposed by some writers, and seems hardly to originate except as an effect of the ingestion of poisons; in this case the history of the individual will prevent error[1]. A patient, observed by Bayle, perished some months after swallowing nitric acid; two or three inches of the lower third of the œsophagus were so contracted, that a quill could scarcely be passed through it; the walls were in a state of chronic hypertrophy with induration, which differed from scirrhous infiltration in wanting its homogeneous shining and semi-transparent aspect. A curious case of constriction of the œsophagus which appears to have been congenital, is related by M. Cassan[2]. The diameter of the tube was reduced to a French line, yet there was not the least morbid change of tissue; the lower part of the pharynx formed a huge pouch containing chymous matter. The subject of this disease had not been seriously incommoded by it until the last year of his life, lived to about 77, and had generally enjoyed excellent health: these circumstances would have distinguished the case from cancer. Dysphagia from *paralysis* of the muscular tunic may be recognised by the absence of pain and the facility with which a probang may be passed into the stomach. The obstruction caused by the pressure of mediastinal tumours, of aneurism of the large vessels, &c. may be distinguished by the physical signs furnished by the contents of the thorax. The exact seat of the disease is to be ascertained by the feelings of the patient; sometimes by the discovery of an indurated mass in the neck in the course of the tube; better by the probang or wax bougie.

In some cases the employment of bougies of gradually increasing diameter has distinctly retarded the fatal issue of the disease, but this cannot be regarded as more than palliative under any circumstances. The introduction of an œsophagus-tube may be necessary for passing food into the stomach; if the object be to leave it *in situ* for some time, it should be introduced through the nares; if it be used at each meal, through the mouth. The feelings of the patient are our best guide in making choice of either of these plans. The mode of introducing the tube is explained in the article Œsophagus. The general treatment of cancerous affections should be adopted. Leeching the throat will lessen irritation and in some cases materially relieve the dysphagia. Nutritious injections and baths are a last resource in cases of total obstruction.

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[1] Med. and Phys. Journ. vol. xlvi. p. 540. 1823.

[2] Bibl. Méd. t. xxxiv. p. 85. 1811.

[1] C. Bell, Surg. Obs. vol. i. p. 82. 1816. Robert, Nouv. Bibl. Méd. t. iv. p. 415. 1827.

[3] Archives de Méd. t. x. p. 79. 1826.

(g.) Abdominal Cavity.—Cancer originating in the small and upper part of the large intestines, in the post-peritonæal, mesenteric, mesocolic, &c. tissues belongs strictly to the province of medicine. Growths thus situated may, however, perforate the abdominal parietes, fungate, and go through the stages of cancerous ulcers. A very interesting case of this kind has recently been related by Mr. Salter[1]. The disease was here probably of the colloid species; its exact seat is matter of doubt, as no autopsy was permitted. Some of the colloid substance discharged from the perforation was "nearly as hard as cartilage"—showing that the jellylike matter came away in lumps still contained in its loculi; under these circumstances, as mentioned in the general description, this morbid substance is exceedingly firm.

(h.) Rectum.—Cancerous disease of the rectum may either exist as a primary affection or be propagated from the vagina, or vicinity of the anus. Frequently consecutive in females to utero-vaginal cancer, it is not uncommonly a primary complaint, and comparatively is rarely attended with multiple development of cancer in distant organs. Usually of the scirrhous or colloid species, the morbid matter may be either infiltrated in the walls of the bowel or present itself as a distinct tumour. In the former case a part only, or the entire, of the circumference of the bowel may be affected; in the latter the tumour occupies a particular spot of the cylinder, and, in the greater number of subjects, its posterior aspect. The progress of the affection is the same as in other hollow viscera: fungating masses spring into the cavity of the gut after ulceration, and may be either firm or soft and pulpy. The diseased structure usually terminates abruptly both at the inferior and superior borders; superiorly the bowel may be uniformly dilated, or form a lateral pouch with hypertrophy of the muscular tunic—in some cases there are, besides, simple ulcerations of the mucous membrane. These different particulars are well exhibited in figure 170, copied from Cruveilhier.

Fig. 170.

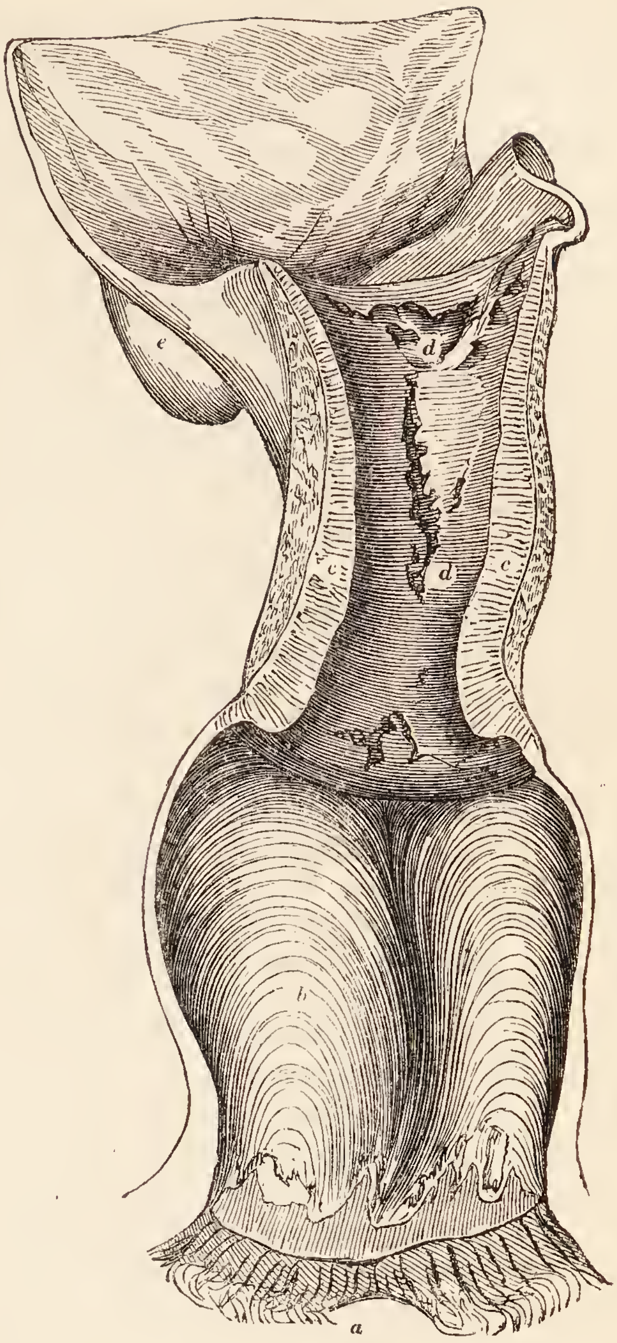

Fig. 170.—a, *Anus;* b, *lower portion of rectum, healthy;* c, *walls of the gut greatly thickened with infiltration of colloid;* d, *ulcerations;* e, *a pouch of the kind alluded to in the text.*

Longitudinal section of stratiform colloid carcinoma of the rectum.

According to the remark of Bayle, small cancerous excrescences form on the skin round the anus, just as in the neighbourhood of mammary carcinoma.

When cancer is primary in the rectum its most common seat is decidedly from two to three inches above the anus; nevertheless Cruveilhier is perfectly justified in affirming that it does commence in all parts of the gut. The tendency of the disease is to spread upwards rather than downwards. Bégin has known it extend to the transverse colon, transforming all the descending portion of that intestine into a scirrhous duct of three or four inches thickness in some parts of its walls, while the inferior three inches of the rectum had not suffered the slightest diseased change. Mr. Mayo has generally found the disease occupy from four to five inches of the bowel, but has seen it involve as many as sixteen. The degree of constriction varies: in Baillie's plates[1], a specimen is figured through which a goose-quill could with difficulty be passed ; but the obstruction may be more complete even than this.

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[1] Provincial Med. and Surg. Trans. vol. v. p. 326. 1837.

[1] Fasc. iv. Pl. iv. Fig. 2.

The symptoms differ in the early stage, according to the form under which the affection occurs : the tuberiform variety appears to be, from the first, attended with pain in the sacral region, the nates, thighs, and hips ; in the stratiform this is slower in appearing. In both a sensation of uneasiness in the rectum, a feeling as if the gut were never thoroughly evacuated, and a consequent repetition of the act of defecation, twice or more in the same day, sometimes accompanied with tenesmus, are among the first effects of the disease. These may have possibly existed for a considerable time, before the morbid deposition has proceeded to any extent ;—the nature of the disease is at this time rarely suspected. Difficulty in defecation progressively increases, a discharge of pus, or muco-pus, frequently accompanies that of the fæces, which are more or less tinged with blood ; the latter may be effused in large quantities, but this is not common. Obstinate constipation, alternating with profuse diarrhœa, the former lasting for days, while the accumulation of flatus and fæces swells the abdomen to an enormous size, now becomes a formidable symptom. The copious evacuation, eventually brought about either by purgatives or by the natural irritation of acrid mucus, leaves the patient in a state of extreme collapse, and a prolonged fainting fit is not uncommon under the circumstances. Before this relief the symptoms may have become those of internal strangulation, nausea, vomiting of fæciform matter, hiccup, coldness of the extremities, vertigo, and even delirium. Irritation is meanwhile set up in the neighbouring parts ; and difficult micturition, or, in some cases, on the contrary, incontinence of urine, follows. Abscesses may form around the intestine, and burst into the vagina, in females ; an occurrence which sometimes produces much relief, from the facility it affords for the passage of the fæces : in males they open into the bladder or urethra, in which case the patient voids both flatus and fæculent matter by that route. In advanced cases there is œdema of the genitals and lower extremities.—Unless relieved by an operation the symptoms increase in violence — the retention of the intestinal contents becomes complete—not even flatus escapes—extreme tympanitis ensues, with the symptoms of strangulation : or rupture of the bowel from fæcal or gaseous distension occurs, followed by fatal effusion into the peritonæum.

Under particular circumstances there may be variation in these symptoms. When the disease is of the tuberiform character, perfectly circumscribed, and limited to a small part of the gut, defecation may be, as in some cases related by authors, easily accomplished to the last, provided there be no considerable protrusion into the cavity of the bowel. Or the patient may suddenly find himself relieved, in a great measure, of his constipation, in consequence of the separation of prominent fungi, or deep ulceration of a protruding mass. Some subjects suffer from constant diarrhœa, and saved thus from the effects of retention, eventually perish with the cancerous cachexia.

The form of the fæces discharged gives good evidence of stricture ; instead of being cylindrical, they are flattened and ribbon-like. This sign is of course wanting in cases attended with habitual diarrhœa. The incapacity of the rectum to receive an enema of the ordinary measure is a useful sign, when the disease, more especially, is seated beyond the reach of the finger. These circumstances, however, throw no light on the nature of the obstruction ; nor does the former always distinguish its seat, for Hevin[1], has observed the same appearance in a case of coarctation of the jejunum. An irregular fæcal tumour forms in the left iliac region.—Examination with the finger, bougies, and the speculum ani, further establish the condition of the gut. The former of these modes requires considerable tact, in order to be made as useful as it is capable of becoming ; and, as Amussat[2] judiciously observes, the student should familiarize himself, by exercise on the dead subject, with the differences in the relations of the part observable in subjects of different age, sex, &c. He also states, that by introducing the finger from behind, the surgeon is enabled to push it much further into the intestine, than if this be done from before or laterally. The situation of the obstruction, its degree, the state of the walls of the gut, the presence of a tumour, or of a stratiform mass, of ulceration, or of fungous formations, are thus ascertained. When the disease is originally seated too high up to be touched by the finger, it may, at a later period, be brought within reach of this from being gradually forced downwards by the accumulation of fæces above it. Cruveilhier was, from this cause, enabled to reach a stricture which post-mortem examination proved to be seated five or six inches from the anus. The characters of the disease may be sometimes ascertained with further accuracy by the soft wax bougie : when the disease is high up in the gut, the use of this instrument is still more valuable, but also attended with difficulty, as in cases of extreme constriction it is no easy matter to find the central canal. This becomes of importance in respect of the treatment, and M. Amussat has endeavoured to overcome the difficulty by some contrivances which will be noticed in the article Rectum, where may also be found directions respecting the mode of introducing the instrument : it is only necessary to state here, that if gentleness be requisite under all conditions of disease, it is essentially so in cases of cancer.—The speculum ani may be advantageously employed, when doubt exists as to the presence or degree of ulceration, &c., provided the affection occupy the lower part of the bowel.

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[1] Mém. sur la Passion Iliaque, quoted by Costallat in Essai sur un Nouveau Mode de Dilatation, &c. Paris, 1834.

[2] Gaz. Méd. de Paris, Déc. 1838; Jan. 1839; Oct. 1839.

It is to be regretted that in his recent calculation of the relative frequency of organic stricture of the rectum in the two sexes, M. A. Bérard[1] has not specified the nature of the morbid contraction in the forty-three instances, of which twenty-three occurred among women, and twenty among men. Judging from the general laws of the disease, it is probable that cancer is here, as elsewhere, more frequent in the female sex; and such is the result of Mr. Copeland's and Mr. Mayo's experience. Desault's commonly quoted estimate is unworthy of confidence, as well from the small number of cases on which it is founded, as the uncertainty of the nature of those cases. Cancer of the rectum is commonly a disease of adult and advanced age; yet it may occur in extreme youth: Mr. Mayo has observed ulcerated scirrhus in a subject of twelve years old. Dionis[2] speaks as if "fungus" of the rectum were an acknowledged effect of pæderasty; the error of this notion is now ascertained.

Various conditions of the gut, dependent on chronic inflammation, are liable to be confounded with cancerous stricture. Thus, *hypertrophy and induration* of the submucous and other tissues of the bowel (simple stricture) produces almost all the local symptoms of the disease under consideration;—this affection is however generally seated higher up in the canal towards the sacro-iliac synchondrosis, is less painful, and more readily influenced by treatment. *Simple chronic ulcer* of the rectum, as of the mucous passages generally, when in the course of cicatrization, is accompanied with fibrous formation and contraction of the tissues engaged in the process: a case of this kind, related by Cruveilhier, was attended not only by the local but the general symptoms of a cancerous affection; the distinction under these circumstances would appear to be scarcely possible during life. However, the similarity to cancerous disease is not always so perfect as in this instance, and the affection may commonly be recognised by physical examination. This appears to have been the fact in a case described by Dr. Hodgkin[3]. It is a curious fact, that the cure of such ulcers in this situation entails much more dangerous effects than the original disease. Chronic inflammation, with *perforations of and partial sinuses in the bowel,* is distinguished by examination with the finger. *Spasmodic stricture* is an affection more written about than observed; of course we exclude from this observation spasmodic contraction of the sphincters, with or without fissure, a condition as painful in its effects as easily distinguished by examination. (See ANUS.) *Paralysis* of the gut is recognised by the masses of fæces of natural appearance, which are sometimes discharged after accumulation in the dilated bowel, and by the absence of constriction as discovered by the finger and bougie. *Enlargement of neighbouring parts,* as of the prostate or uterus, displacements of the latter organ, tumours of the mesentery or ovary, urinary calculi[1], a pessary[2], may produce extreme difficulty in defecation: careful examination of all the parts concerned is requisite to assure ourselves of the nature of the obstruction.

In the medical treatment of the disease, our most important object must be to facilitate, as far as possible, and by the most gentle and unirritating means, a regular action of the bowels. Simple enemata of warm water, with gentle laxatives, will commonly suffice for the purpose for some time; at a more advanced period, medicines of greater activity may be absolutely required. Mr. Mayo advises a few drops of laudanum to be taken after each evacuation. But however necessary it may ultimately become, there is a strong objection to the use of opium, whether in the form of suppository or otherwise, in its tendency to increase constipation and retard the periodical evacuation by which some patients are relieved: large doses of hyoscyamus are preferable, so long as they produce a sufficient anodyne effect. Leeches to the sacrum or perinæum, mitigate pain and lessen spasm. Sir B. Brodie advises the use of linseed oil in injections, either pure or combined with lime-water, for relieving irritation, and alkalies with balsam of copaiba internally.

Upon the advisability of attempting to dilate carcinomatous stricture of the rectum with bougies or other contrivances, opinion is divided. Although we find Bégin affirming that he has been very successful in the treatment of this affection (when so situated as to be unfit for removal with the knife), by the application of leeches through the speculum to the diseased part, and by compression, it is just to add, that the majority of practitioners, especially of our own country, regard the plan not only as useless, but injurious. And it argues ill for M. Bégin's performances, that the case he has chosen to illustrate them, was probably not carcinomatous, and under all circumstances, only temporarily benefited. There can be little question, however, of the propriety of using the bougie as a palliative, when the obstruction begins materially to affect the excretion of the fæces;—necessity then points to its use. In more fortunate cases its occasional employment is sufficient, producing a degree of relief which carries the patient successfully through for some days, or even weeks: in other instances it becomes necessary to introduce it before each evacuation. This, after a while, excites irritation, sometimes such as the patient cannot endure; and when the cancer is ulcerated, and the seat of tender, soft, and hæmorrhagic fungous growths, catheterism of the tube becomes impossible. Here the disease cannot even be relieved, except by an operation. Mr. Mayo has recourse to divisions of the mass with the knife in cases of fungoid scirrhus, when the sensibility is so extreme, and the growth so large, that the bougie cannot be borne or introduced. A case is related in which this mode of widening the channel was productive of relief. We may state here that Mr. Stafford has recently [1] recommended the division of the gut when, among other conditions, "carcinomatous ulceration is likely to occur; the freeing the part, and thus relieving the irritation kept up in (is?) the most likely way, although it cannot be depended on with certainty, of preventing the mischief." Analogy is certainly strongly opposed to this idea; incising a scirrhous breast would be rather an unlikely way of delaying the occurrence of ulceration: but if experience be on Mr. Stafford's side, theoretical objections are of course without force.—A variety of materials have been employed as dilating bodies, cylinders of shredded lint (*mèches de charpie*), elastic gum bougies, soft wax, tallow candles, Arnott's dilator, the Fucus Esculentus[2], ivory softened in an acid (Mr. Alex. Ure), &c.; but the softest of these are decidedly to be preferred in carcinomatous cases.—The introduction of a hollow tube, through which water may be injected, and the fæces washed away, is recommended, and is sometimes, but this is rare, of real use: as Desault long since remarked, even flatus cannot, in many cases, be made to escape through it.—Galvanism has been tried as a means of stimulating the intestinal fibres to action, but little is to be hoped from its employment.

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[1] Gaz. Méd. Mars, 1839.

[2] Cours d'Opérations, p. 320.

[3] Bright's Reports, vol. i. p. 117.

[1] Tulpius, Obs. Med. lib. iii. cap. 2.

[2] Marquet, Traité de l'Hydropisie, &c. p. 160. 1770.

M. Amussat is in the habit of treating cancerous ulcers and fungosities by cauterization with a stick of caustic potass or nitrate of silver; following up this plan, after the separation of the eschars, by compression and dilatation. The dangers attending cauterization of the cervix uteri are increased in the instance of the rectum by the greater difficulty of the operation; and the amount of benefit thus obtained is not stated.

The process of breaking down fungous masses in the rectum can never be more than palliative: as an example of its results we subjoin the following abridged account from the practice of M. Amussat. A man ætat. 62, presented a carcinomatous ulcerated ring surrounding the intestine, measuring 1¾ inches in length and commencing 2½ inches above the sphincters: the coarctation was almost sufficient to prevent the finger from passing into the narrowed part. The ligature, dilatation, or excision were decided in consultation to be inapplicable—the latter from the fear even of slight hæmorrhage which, it was apprehended, must have carried off the patient. The most prominent granulations of the mass were consequently broken up with strong pincers: the operation is said to have been scarcely felt by the patient, and attended with no hæmorrhage. Eight days after M. Amussat commenced cauterizing, repeating this every third or fourth day for a considerable time. The tumour was thus reduced to half its previous size; but, notwithstanding this, the patient's condition grew more and more alarming, and it became necessary to form an artificial anus to save his life.

Extirpation may be undertaken, either when the disease consists of a distinctly circumscribed tumour, or of a stratiform mass involving part of or the entire circumference of the gut. A tumour may be removed by ligature or excision. The former operation, which saves the patient from the risk of hæmorrhage, may be done with a silk thread, if the basis of the growth be narrow: with silver wire under the contrary circumstances.

The removal of a mass encircling the gut is an operation of greater importance. Velpeau states [1] that an inch and a half of the entire circumference was successfully excised by Faget in 1739—defecation proceeding with the new anus as comfortably as in the natural state of the parts. The merit of reviving this operation in the present century rests with Lisfranc. Among nine operations of the kind performed by this surgeon before 1830, five terminated by a cure; in one instance the issue was doubtful; three cases ended fatally. In two of the latter, purulent effusion in the pelvis and phlebitis were the causes of death; the body of the third subject was not opened. Mr. Mayo has, also, removed in one instance a portion of the entire cylinder of the rectum; the patient was exceedingly benefited by the operation; she had prolapsus afterwards however, and died of inflammation in the abdomen two years after. It is indispensable for success that the limits of the disease be within easy reach of the finger (three inches have been removed), and that the surrounding cellular tissue be healthy, so as to permit the bowel to be drawn down with facility during the operation. Should the entire substance of the parietes be affected, the case is unfit for operation if the disease extend more than an inch above the anus.

Velpeau describes the steps of the operation as follows. The patient having been placed on his side, as in the operation for fistula in ano, with the thighs kept apart by a pillow and flexed at a right angle on the trunk, the anus is encompassed by two semilunar incisions joining anteriorly and posteriorly, and the resulting flaps dissected up to the edge of the sphincter. The left index finger is then introduced for the purpose of bringing down the diseased mass as low as possible, while an assistant draws the dissected ellipse of integuments in the same direction. The surgeon then cuts away the adhesions of the diseased gut by semi-circular sweeps of the knife, and finishes by dividing the intestine transversely either with the bistoury or with curved scissors. When the cancer is deeply seated or extensively adherent, Lisfranc divides the posterior angle of the dissected ellipse with strong straight scissors, extending this division tolerably high along the rectum: the dissection is facilitated by an assistant drawing down the gut with hooks or strong forceps. The knife of the operator is guided by a finger in ano, and by the thumb placed on the external surface of the flap. One of the most important points to bear in mind is the position of the hollow organs in front of the gut. Their situation may be marked by the finger of an assistant in the vagina, or by a sound in the male urethra; but these guides will be of little value unless the operator possess perfect anatomical knowledge. M. Costallat states that "an autopsy which took place at the Venereal Hospital shows, that through the action of a cancer situated at the inferior part of the rectum, the *cul-de-sac* of the peritonæum may be brought within sixteen lines (Fr.) of the anus; whereas in the normal state, it is double or even treble as far from the orifice of the bowel." This is an anatomical fact of most serious importance.—The arteries should be tied when divided; when this precaution has been taken there is rarely any severe hæmorrhage, or such as resists the application of lint steeped in cold water. A thick roll of shredded lint is introduced after the operation, and in order to prevent the tendency of the intestine to coarctation from becoming troublesome, the use of some contrivance of the kind should be persisted in for a time—say, a few weeks at least. The wound commences to contract from the fifteenth to the twentieth day,—the external and internal parts approximate, and eventually the visible loss of substance does not amount to more than an inch in width. The fibres of the levator ani, the aponeuroses and the end of the rectum form a sort of substitute for the sphincter: the patient, however, has commonly no control over liquid fæces, though the individual operated upon by Faget could even retain flatus. Whatever may have been the success of Lisfranc, opinion is far from being strongly favourable to this operation, even in Paris: Amussat affirms that it "rarely succeeds." It may be observed, however, that the indication for removing a portion of the rectum obstructed by cancer is infinitely strongly than for the amputation of a cancerous breast. In both situations, it is true, the disease must destroy life, unless removed—but in the case of the rectum the free discharge of the function is demanded for daily existence. The comparative rarity of visceral contamination in rectal cancer, is a general argument in favour of excision.

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[1] Ed. Med. and Surg. Journ. vol. li. p. 363. 1839.

[2] Aitkin, Prov. Med. and Surg. Trans. vol. vii. 1839.

[1] Méd. Opérat. t. iii.

Surgery has yet another mode—in the establishment of an artificial anus—of relieving sufferers from obstructed rectum, and of warding off imminent death. There are at least seven cases on record in which this operation has been performed on the adult subject, when every effort to relieve the distended bowels having been made in vain, symptoms of stercoral tympanitis and strangulation with momentary risk of rupture of the intestines had set in. Five of these operations proved completely successful, and in one of the others the fatal event was mainly due to previous unskilful treatment: the operation is therefore warrantable in a surgical point of view[1]. When the indications for performing it arise, the patient should be allowed to choose for himself between certain death and the prospect of life with the inconveniences of an artificial anus, which the formation of such an opening affords. When the disease is cancerous, the chances of ultimate advantage are, of course, vastly less than in cases of retention from simple induration; but even here it may be justifiably performed, provided the patient, after having been made fully acquainted with the nature and likelihood of the benefit to follow, still desires to undergo it. All particulars connected with the manual part of the operation, and the respective merits of the plans of Littre and Callisen (that of the latter revived and modified by Amussat) will be considered in the article Fistula, Intestinal. For Bibliography see Rectum.

(I.) Anus.—The neighbourhood of the anus is probably more frequently the seat of cancerous disease than the interior of the rectum. The disease originates in scirrhous infiltration of the lower part of the walls of the gut; or, as a cutaneous warty excrescence; complicates ulceration of syphilitic origin; or, as Cruveilhier states, "succeeds to irritated hæmorrhoids."

The induration attending the progress of the disease obstructs the functions of the part, and defecation becomes difficult and painful; but as stricture is rarely induced—the orifice is on the contrary often widened by spreading ulceration — the effects are much less severe, than when the affection is seated in the interior of the rectum.

Prolapsus of the lower part of the bowel, with an hypertrophous state of its walls, is frequently mistaken for cancerous induration: a mass of this kind, removed by Boyer as carcinomatous, is figured in Cruveilhier's twenty-fifth Fasciculus; the induration was here increased by the presence of numerous phleboliths. Bayle is of opinion that elephantiasis of the vicinity of the anus—a local form of the disease which he has carefully described—is only distinguishable during life from cancerous ulceration by the absence of cachectic symptoms and the prompt benefit afforded by dilatation.

The true remedy for anal cancer is excision. The operation we have, in conformity with general habit, described under the head of cancer of the rectum, is really only applicable when the disease spreads from the anus:

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[1] See Medical Gazette, July, 1840.

if it originate in the interior of the rectum, the lower inches of the bowel are, as has been stated, generally healthy, and, from its situation, it is unfitted for extirpation.

IX.—*Air-Passages.*

(A.) Nares.—Cancerous disease of the nares, which is most commonly encephaloid, produces the mechanical effects common to all growths obstructing these passages, such as interference with the ingress and egress of air from the lungs, and as has occasionally been witnessed, obliteration of the lachrymal sac followed by fistula lachrymalis, &c. The pain, hæmorrhages, and discharge are of the ordinary kind.

Tumours appearing in the nasal fossæ may not have originated in those cavities. We have already seen this fact illustrated in the history of perforating cancer of the meninges, and further information on the point will be found in the articles Orbit and Maxillary Sinus. M. Cruveilhier refers to a singular case wherein a mass, having the appearance of a fibrous polypus, occupied the right nostril, and was, on post-mortem examination, found to consist of a portion of dura mater, thickened, exhibiting a fungous surface, and containing within it the corresponding parts of the arachnoid and pia mater along with some cerebral substance and pus, the whole forming a hernia through the cribriform plate of the ethmoid bone. The chief safeguard against ill consequences in such cases appears to be in the fact, that the state of disease must be so advanced as to contra-indicate any attempt at operation. The commemorative symptoms will also sometimes guide us in the diagnosis, and should, under all circumstances, be carefully inquired into.—The *seat* of the disease being ascertained to be in the nose, its *nature* remains to be established. It may be mistaken for different kinds of nasal polypus, but the ordinary effects of cancer are usually sufficiently marked to ensure us from error. See Nares.

Palliative treatment only is indicated in cancerous disease of the nostrils; should respiration be seriously impeded by abundant growth of encephaloid fungi, these may be cut or torn away, but this is only a measure of temporary utility, as they are rapidly reproduced. The hæmorrhage resulting from their excision in particular may be extremely difficult to control.

(B.) Maxillary Sinus.—See this word.

(C.) Frontal Sinuses.—The following particulars of a case of carcinoma of these cavities are abridged from the original history by Desgranges, recently published in L'Expérience by the learned editor M. Dezeimeris[1]. A man, aged twenty-five, presented himself at a provincial hospital with a tumour situated at the root of the nose. Two years before he had had confluent variola. attended with violent cephalalgia from which he was never afterwards wholly freed. He suffered besides from stuffing in the nostrils, frequent sneezing, and desire to clear the nose. The frontal pain increasing, occasionally assumed the lancinating character; and at the end of fifteen months the bone, immediately above the root of the nose, appeared to bulge out. This prominence gradually increased, was at first hard and insensible, but subsequently became somewhat tender. Impaired olfaction, severe itching in the nares, with puriform discharge now supervened. On his admission, the external tumour was as large as a hen's egg, the investing integuments engorged, œdematous, and slightly red. The bone covering the tumour seemed exceedingly thin, and obscure fluctuation perceptible. A "malignant fever" carried off the patient fifteen days after his admission. The prominent part of the bone was found to be extremely thin, cracked, and ready to separate into fragments. On removing this lamella—the anterior wall of the frontal sinuses—a tumour springing from the lining membrane of those cavities presented itself, somewhat flattened on its posterior, convex on its anterior surface. Smooth and reddish externally, a section of this growth exhibited superiorly a solid, firm, sarcomatous or scirrhous tissue, very slightly tinged with red,—inferiorly a humid, redder, and softer substance, as it were decomposed and covered with a sort of purulent mucilage; the latter could not be removed without scraping away some of the tumour, which then bled. The septum of the sinuses had totally disappeared; the size of these cavities was greater than natural; and the opening, communicating with the ethmoid cells, widened and plugged with engorged pituitary membrane, apparently inflamed and purulent. The internal plate of the frontal bone presented its natural aspect; the posterior lamella of the sinuses of ordinary thickness, was of red brown colour, as in the bones of young subjects. The corresponding dura mater adhered but slightly to the cranium; towards the crista galli appeared varicose vessels which bled abundantly. The venous sinuses, as also the vessels of the dura mater and cerebral substance, were likewise engorged with blood.

The characters of an encephaloid tumour partially softened may be recognised in these details. The progress of the disease was closely similar to that of perforating cranial cancer; and the healthy state of the posterior wall shows that extirpation of the tumour might have been undertaken with reasonable prospect of success.

(D.) Sphenoid Sinuses.—Dr. Carswell[1] has given an engraving of an encephaloid growth originating in this situation, and protruding through the substance of the bone into the cavity of the cranium. Dr. Bright[2] speaks of a similar case; the patient had suffered from facial neuralgia.

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[1] No. 36, Avril, 1838.

[1] Element. Illustrations, Carcinoma, Fasc. II. Pl. II. fig. 7.

[2] Reports of Med. Cases, vol. ii. p. 506.

(E) LARYNX.—Examples of cancer of this organ, especially of the primary kind, are exceedingly rare. The following abridgment of a narrative by M. Louis of such a case, consequently possesses no ordinary interest.

In a subject dying with extensive pulmonary emphysema and hypertrophy of the heart, "the epiglottis was somewhat thrown to the left side, but healthy. Immediately underneath it appeared a mass of white, hard, firm matter, creaking when divided with the scalpel, shining, without distinct structure, extending to the right and backwards between the thyroid and cricoid cartilages, not protruding above the superior border of the former, and very little beyond the posterior edge of the arytænoid, which was itself transformed into similar cancerous matter, without being, at least in its entire extent, continuous with the rest of the diseased formation. The cancerous mass, of a wedgelike shape, measured three-quarters of an inch in thickness posteriorly, somewhat less in front. Of creamy consistence in its interior, it lessened the calibre of the larynx materially on the right side, where the chordæ vocales were destroyed; a diminution increased by another similar but much smaller mass, placed under the left inferior chorda vocalis, which was non-ulcerated. The thyroid cartilage was healthy, the cricoid ossified throughout; the arytænoid muscle terminated on the right in the cancerous substance. The mucous membrane of the trachea was pale and of normal thickness and consistence; the œsophagus healthy." No other organ in the body contained cancerous matter. Nine months before the patient's death the voice was affected without being completely lost; for the last four months, at least, he suffered from permanent aphonia. There was but little cough, but this had a clanging character; the patient never complained of pain in the larynx, and upon two occasions only, when some drink escaped through the nostrils, did he suffer from dysphagia. There was no irregularity noticed in the form of the neck; the patient was gay, but emaciated, and the skin of an earthy tint. The existence of the disease does not appear to have been ascertained during life.

To Professor Albers, of Bonn, the profession is likewise indebted for two well related examples of primary encephaloid of this organ. But M. Trousseau has contributed a case more directly interesting to the surgeon than either of those referred to, as in this instance the medical attendants were obliged to have recourse to tracheotomy to avert imminent suffocation. The subject of the operation, a woman aged thirty-two, continued well for five months after its performance; the canula being during this period retained in the trachea, and the patient enabled, by closing the orifice of the instrument, to speak with very efficient loudness. Nine months after a tumour, detected at the left inferior part of the larynx at the time of the operation, suddenly acquired a great increase of bulk, and sprouting out between the canula and the upper edge of the wound, soon ulcerated and became the seat of frequent hæmorrhage. Pleurisy with effusion supervened, and the patient died hectic. A multitude of tumours of various sizes, in bunches or isolated, almost filled the larynx, covering the epiglottis and part of the trachea, and, protruding externally, formed a mass as large as a moderate sized apple; these were of irregular form, and covered with livid, attenuated, and ulcerated skin: numerous similar tumours appeared in the adjoining cellular tissue. The laryngeal mucous membrane between the tumours was ulcerated and fungous; the left arytænoid ligament converted into the diseased matter; the cartilages, broken into fragments, implanted in the middle of the tumours. The latter creaked under the scalpel when divided, were firm, and of the colour of the substance of an Indian chesnut. They possessed the humidity of encephaloid, though the smoothness and the colour of their divided surface assimilated them more to tubercle. The others were softened and converted into yellowish pulp. M. Cruveilhier pronounced the disease to be of cancerous nature.

BIBLIOGRAPHY.—*Morgagni*, De Sed. et Caus. Morb. Ep. 28, cap. 9. *Pelletan*, Clin. Chirurg. t. i. p. 15. 1810. (This was in all probability a fibrous tumour, though described as scirrhous.) *Albers*, Ueber durchbohrende Geschwüre der Speiseröhre und der Luftwegen, in Gräfe & Walther's Journal, bd. xix. s. 1. 1833. The same in the same, bd. xxi. s. 527. 1834. *Louis*, in Mém. de la Soc. Méd. d'Observation. t. i. p. 169. Paris, 1837. *Trousseau & Belloc*, Traité de la Phthisie Laryngée, p. 132. Paris, 1837.

X.—*Genital Organs.*

1. MALE. (A.) PENIS.—Cancer of the penis is almost invariably of the schirrous species, and in the vast majority of cases commences in the glans or prepuce.

Scirrhus may originate as a warty excrescence, either on the surface of the prepuce, the glans, or the frænum; or infiltrate the glans, and convert that part into an indurated mass; or first attract notice, as a "pimple" which discharges an excoriating fluid, scabs and breaks out afresh, while ulcerations and induration advance at its base: or venereal ulcers may become complicated by carcinomatous deposition and fungate in the same manner as primary cancer. Encephaloid, which has very rarely been observed in this organ, exhibited itself in a case treated by M. Buret as a tumour, of the size of a pigeon's egg, situated between the fibrous membrane and skin of the dorsum; the interior of the growth had exactly the appearance of semi-putrid infant brain.

M. Buret states that the fibrous sheath of the corpora cavernosa, and the erectile tissue of the urethra, may be the primary seat of the disease; in whatever situation it originates it commonly soon involves the rest of the organ. Months may, however, pass over, before induration, beginning in the glans, spreads to the corpora cavernosa; this is, besides, slow in passing into the ulcerated stage, sometimes producing a sensation of weight, slight aching pain, and difficulty in micturition, for a number of months, or even years, before this change occurs. The progress of the warty excrescence is usually more rapid. The discharge from the ulcerated surface is abundant, and the cauliflower fungating masses produced sometimes reach a large size, forming with the swollen glans and prepuce a mass as big as the clenched hand. According to M. Buret, when the disease is seated in the skin, prepuce, or cellular tissue of the penis, the inguinal glands are first engorged; on the contrary, the pelvic suffer earliest, when the more deeply seated parts are affected. The constitutional symptoms are those characteristic of cancer. In rare cases the disease becomes stationary in the penis, and the patient perishes from the active progress of consecutive cancers in the glands and viscera.

Several practical surgeons, among others Hey, Boyer, Roux, Travers, and Bégin, coincide in remarking on the frequency of phymosis, either congenital or acquired, in individuals labouring under cancer of the penis. The confinement of the smegma preputii, and of drops of urine thus induced, is supposed to be the cause of the disease; whether the explanation be correct or not, the fact itself is of much practical importance, and almost a sufficient reason for circumcising individuals thus formed or affected. Cancer, however, occurs in subjects differently conformed; we remember to have observed it in a person whose glans had been uncovered from childhood, and three out of twelve of the patients treated by Hey were free from phymosis; the disease is most common in adults, and more especially in subjects of rather advanced age[1].

M. Buret has twice observed a peculiar indurated state of the lateral anterior half of the penis; the tissue thus affected is dense, firm, indolent, and diminished in size, and the organ becomes curved in that direction during erection. This condition is perfectly distinct, he conceives, from scirrhous hardening, but he does not state the means of distinguishing them.

Removal of the disease affords the only chance of saving a patient affected with cancer of the penis, and few surgeons admit that mere excision of the actually cancerous part is sufficient. Mr. Travers "holds it to be quite useless to remove the prepuce alone in any case of malignant sore or excrescence, however the glans may be free from ulceration; and M. Bégin expresses himself in a similar strain. M. Lisfranc, however, professes different notions: having dissected penises, removed as extensively carcinomatous, in which he ascertained that the disease was only superficial, and did not involve the corpora cavernosa, and further reflecting on the power of the albugineous tissues to resist cancerous infiltration, this surgeon decided upon trying whether amputation of the organ (the effects of which on the *morale* of the sufferer he describes in piteous but probably not exaggerated terms) might not be safely given up for excision of the affected parts. Here we have, to a certain extent, a revival of principles taught by Callisen[1]. In order to ascertain the depth of the disease with certainty, M. Lisfranc recommends the diseased mass to be cautiously divided through the centre down to the fibrous sheath; if this be healthy the disease may be excised; if not, amputation must at once be performed. To this mode of procedure it may be objected that, although the fibrous tissue appears healthy, it may really contain germina of the disease; that the operation is longer, and the incision useless, if amputation be eventually required. The real value of the first objection—though, from what we have already seen, specious even in this case—is to be decided by experience; as to the others, there are few patients who would not willingly submit to a little additional pain for the chance of retaining the implicated organ. But under all modes of operation the prognosis is unfavourable. Mr. Travers assures us that "if the penis be amputated at some distance beyond the hardened part, and before the disease has existed long, the patient may escape a return of it; but this is a rare instance of good fortune. Slight symptomatic enlargement of the glands in the groin should not be accounted a bar to the operation, and, on the other hand, the absence of all glandular affection is no security against its return and fatal termination in three months." Some forms of the disease are, however, according to the same surgeon, more favourable for operation than others; the "irritable pimple," either of the glans or prepuce, breaking into hard-based, spreading, and fungating ulcer, is more likely to be followed by reproduction than the form commencing as a warty excrescence.

Amputation practised immediately behind, or even at a certain distance from the glans, does not render the organ altogether unfit for the performance of its functions. In evidence of this M. Buret quotes Scultetus: in a case of carcinoma treated by this surgeon, "maximâ penis portione, præsentibus magistris J. Pasboom et M. Klonkhuysen, exsectâ, vulnus consolidatum nec urinandi nec seminandi ullam fecit remoram, et diffractâ hastâ ipsam ausus est (æger) aggredi Helenam." Reproduction of the disease may either occur in the stump, in the inguinal glands, or in internal organs, and either in the scirrhous or encephaloid forms.

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[1] Like other organs, the penis is said to become the seat of cancer occasionally, through the immediate action of common irritation, but when this is the case the subject must be strongly predisposed to the disease: such, doubtless, was the constitutional state of the unfortunate "gentilhomme dont le prépuce avait été morcelé par un cadenas d'or imposé par la jalousie d'une Italienne, et dont la verge, devenue par suite cancéreuse, fut amputée par Dupuytren." See Legros in L'Expérience, No. 58. Août, 1838.

[1] Syst. Chir. Hod. p. 420. 1800.

In the article Penis the reader will find the operation of amputation described. Ligature of the diseased organ, practised by Ruysch and recommended by Heister and Courcelles, is a proceeding justly banished from modern surgery.

Buret, Journ. Hebdom. t. i. p. 377. 1828. *Lisfranc*, Mém. sur les Cancers superficiels qu' on croyait profonds; Gaz. Méd. de Paris, p. 249. 1830.

(b.) Prostate Gland.—True scirrhus is of singularly rare occurrence in the prostate. Mr. Travers has found the organ occupied by a small tumour, possessing all the characters of scirrhus; and met with instances in which the stony hardness and enlargement of the gland, the bloody seminal discharge; and the peculiar pains felt in the thighs and elsewhere, seemed to leave no doubt of its being the seat of that form of cancer. Sir B. Brodie relates two cases of presumed scirrhus of this organ. "There was a constant and severe pain referred to the neck of the bladder, which was not relieved on the urine being drawn off. The urine deposited a considerable quantity of adhesive mucus, and was of an ammoniacal odour. [This is mere evidence of the existence of chronic cystitis.] The prostate was found on examination to be much enlarged, and of a stony hardness. The patient complained of excruciating pains in different parts of the body, which could be compared to nothing except the pains under which persons afflicted with carcinoma occasionally labour. He subsequently suddenly became hemiplegic, and died in a fortnight." The last circumstance is exactly similar to what was observed in a case related from the same author, under the head of mammary cancer, and depended, as he conjectures, on the same cause [1].

Mr. Langstaff [2] has described an encephaloid tumour, as large as an orange, springing from the prostate, and chiefly from its "third lobe;" it had occasioned absorption of as much of the mucous coat of the bladder, as allowed of its getting into the cavity of that organ, had extended laterally, and completely plugged up the orifices of both ureters: the urethra was nearly closed also. The patient, aged 68, had suffered under vesical symptoms for upwards of five years, and for the last six months with most excruciating pain in the regions of the kidneys and bladder; he voided his urine in drops, or in a very small stream, had pain in the rectum, and was costive. The existence of enlargement of the prostate was ascertained, by examination through the rectum: one of the smallest sized bougies passed with great difficulty. The patient suffered from continual hæmaturia towards the close: death was immediately caused by rupture of the right ureter and effusion of three pints of urine and blood behind the peritoneum. The liver and lung also contained encephaloid growths.

In the following case, observed by Mr. Stafford, the disease proved fatal from its influence on the urinary functions before the occurrence of ulceration. A boy, ætat. 5, having been for three or four months subject to "irritable bladder," voiding his urine very frequently, and remarkable for the tumid state of his belly, was brought to the Marylebone Infirmary with complete retention, complaining of no pain, but restless and irritable, with an anxious and depressed countenance, furred tongue, and considerable fever. A small elastic gum catheter was passed without difficulty, and twenty-five ounces of urine of natural colour drawn off. The power of voiding the urine naturally being totally lost, the catheter was used twice daily, and at length, from the rapidity with which the urine accumulated, left in the bladder altogether. The boy gradually sank, and died on the eighth day after admission. The prostate was found to be of globular form and as bulky as the largest walnut; the so-called third lobe to be nearly as large as a small hazel-nut (about the normal size of the entire gland in a subject of this age); the section of one lateral lobe exhibited the colour, consistence, and texture of encephaloid, in one part apparently mixed with melanotic matter. The abdominal and thoracic viscera were healthy, nor was any other cancer discovered [1].

(c.) Testis and Epididymis. (See Testis.)

2. Female (a.) Uterus. (See Uterus.)

(b.) Ovaries.—Cancer of the ovary may either exsist as an extension of the disease from the uterus; originate independently of, but subsequently to, the formation of cancer in the latter organ; appear as a primary affection, or consecutively to the growth of carcinoma in distant organs. Its occurrence under the latter circumstances is regarded by Cruveilhier, as we have already mentioned, as extremely rare. Without being able to state the frequency of ovarian cancer with any precision, we are justified in affirming that it is far from uncommon; and that while Bayle has fallen into a most singular error in almost questioning its occurrence, Boivin, Dugès, and Dr. F. Churchill, exaggerate materially in considering it more frequent than carcinoma of the mammæ.

Scirrhus and encephaloid of the tuberiform and infiltrated kinds occur in this organ; but we are not aware that true alveolar colloid cancer has yet been discovered in it. The carcinomatous affection may be the sole disease present: when this is the case, and when it assumes the tuberiform character, the substance of the ovary may sometimes be found on the external surface of the diseased growth in an atrophous state, or of the natural dimensions: when the morbid matter is infiltrated through the ovarian tissue, the vesicles of Graeff may present the natural appearance[1]: occasionally, as in one of Dr. Bright's cases[2], the deposition seems to occur in the wall of one of these vesicles. In another class of cases the carcinomatous matter, originating in the walls of multilocular, or much more rarely of unilocular cysts, forms a complication of pre-existing disease.

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[1] Dis. of Urinary Organs, Ed. 2, p. 161.
[2] Loc. cit.

[1] Med. Chir. Trans. vol. xxii. p. 218. 1839.

The different varieties of scirrhus and encephaloid exhibit themselves in this organ; those of the latter more frequently than of the former. Bistre-coloured, or true melanotic deposition, is not uncommonly superadded. When formed in the walls of cysts encephaloid frequently co-exists with fibrous, cartilaginiform, calcareous, or ossiform transformation of those walls; and numerous cases, in which the diseased formation consisted simply of cysts, of which the walls had been converted intro fibrous tissue, have been erroneously described as scirrhus of the ovary.

Encephaloid growths vary in size in this organ from that of a pin's head, as we have detected them under the serous lining of cysts, to that of the fœtal head, or upwards. They are rarely, however, observed to attain very large dimensions here, unless when developed in the walls of cysts; under these circumstances, the entire formation has been known to weigh fifty-six, sixty, and seventy-five pounds, or even more. Mr. Warren describes the removal of a "scirrhous ovarium, of almost cartilaginous hardness, containing neither cavity nor fluid, which weighed about twenty-five pounds;" it may be objected to this statement, however, that no proof is given of the truly scirrhous character of the growth.

The disease is usually confined to one ovary, though it not unfrequently affects both. Conception may occur repeatedly in the former case, as is shown by numerous examples of the fact on record. Mr. Hewlett has related the case of a female delivered at the full time, though both ovaries were the seat of extensive encephaloid disease: it seems doubtful whether the disease existed in both organs at the period of impregnation (in which case the læsion of structure must have been limited on one side), or was subsequently developed; the latter, judging from the history of the case and the species of the cancer, was most probably the fact[3].

Dr. Seymour conceives, he has ascertained, that scirrhus of the ovary rarely softens, and refers to a preparation in the College of Physicians as a very singular specimen of such change[4]. Encephaloid of this organ is not thus distinguished.

The morbid mass contracts adhesions with surrounding parts in many, but in what exact proportion of cases, is yet matter for inquiry. If these adhesions occur in an early stage of its growth, they connect it with the uterus, rectum, or pelvic peritoneum; if at a later period, with the omentum, colon, small intestine, or abdominal portion of the serous membrane. The Fallopian tubes in some instances continue free, but more ordinarily become firmly united with the tumour, round which they twine, undergoing a degree of elongation corresponding to its increasing dimensions.

The local symptoms of ovarian carcinoma are mechanical and functional. The former follow precisely the same course as those of ovarian tumours in general, changing with their size and position in the pelvis or abdominal cavity.

The condition of the catamenia varies: they may be irregular, absent, or, as is observed in comparatively rare instances, undergo no change from the healthy state. Lancinating pain is very far from a common attendant on carcinoma in this situation; nor is it possible, upon the foundation of cases hitherto published, to point out any series of symptoms that can be called characteristic of cancer of these organs: that is, of symptoms whereby simple carcinomatous tumours may be invariably distinguished from other diseased enlargements of these parts, or whereby the period, at which deposition of cancerous matter in the walls of encysted formations arises, may be announced: yet we are far from believing that by patient, minute, and extensive observation of ovarian disease, such characteristic symptoms might not be found to exist: however, until such observation be undertaken, we can scarcely object with justice to the habit of practical writers, who, in spite of the evidences of pathological anatomy, continue to group encysted growths and true carcinomatous tumours under the same head of "malignant disease" of the ovaries. In order to avoid repetition, we must refer the reader for the symptoms of cancer of these organs to the general article Ovary. The cancerous cachexia is slow in occurring and ill marked.

With respect to the state of other organs, we have already mentioned that Cruveilhier regards the secondary development of cancer in the ovary, unless when a sequence of its existence in the uterus, as singularly rare. It has, however, been found co-existing with cancerous disease in various organs; and examples of multiple development, under these circumstances, may be found in numbers in Dr. Bright's essay already referred to.

Death, in cases of ovarian cancer, more commonly depends upon the changes occurring in, or on some effects produced by, the encysted formations to which the carcinoma is usually superadded, than on modifications having their seat in the latter. The fatal event appears in many instances the result of progressive exhaustion and sinking of the vital powers, no particular morbid change being discovered to account for it; but in the majority of cases it is immediately brought about by inflammatory action in the cyst itself or in the peritonæum. The inflammation of the serous membrane originates sometimes without any evident cause; more commonly from the escape of the contents of a cyst into its cavity, the effect either of natural rupture (which may be spontaneous or produced by a fall or blow), or of the operation of paracentesis. In some very rare instances—such a case is reported by Dr. Bright—effusion of cancerous matter into the peritonæum has been observed. The escape of the encysted fluids may take place into the intestines, and the diminution of the tumour coadvance with diarrhœa[1], or into the vagina[2].

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[1] Bouillaud.
[2] Guy's Hosp. Reports, vol. iii. p. 179. 1838.
[3] Med. Chir. Trans. vol. xvii. p. 226. 1832.
[4] On Diseases of the Ovaries. Lond.

Of the causes of ovarian cancer nothing is known: much hypothetical matter has been written on the influence of gestation, abortion, suppression of the lochia, &c.; the unsatisfactory character of this may be ascertained by perusing the published histories of some dozen patients. Boivin and Dugès affirm that it is most common in single persons[3]: this too may be doubted.

The diagnosis of ovarian enlargement is often exceedingly obscure; let us suppose, however, that an abdominal tumour has, by the rules laid down in the article Ovary, been distinctly ascertained to exist in that organ, and not in the substance of, or in connexion with, the uterus, mesentery, intestines, kidneys, spleen, or liver,—that the female is neither pregnant nor affected with ascites—the *nature* of the morbid development remains to be decided.—If well-marked cancerous disease coexist in some other organ with the ovarian tumour, the latter is probably carcinomatous: if no other part is apparently carcinomatous, and the cancerous cachexia is established, we are entitled to infer that the affection of the ovary is of this character, with a degree of confidence proportional to the surety of our diagnosis in respect of other parts. But both of these general guides may be absent, or may fail us: we must then depend on the local characters of the disease.—*Fibrous tumours of the ovary* may, when large, be distinguished from scirrhus by their size; from encephaloid, by their hardness, inferior elasticity, smoother non-lobulated surface, and uniform consistence in every part. The condition of the patient's health will, in some instances, facilitate the distinction.—*Unilocular cysts* are non-lobulated; they usually contain a serous fluid, in which case the fluctuation of this will readily prove that the mass of the tumour does not consist of cancerous matter; and even when the contents are of a gelatinous character, the phenomenon is sufficiently well marked to prevent mistake. The constitution suffers little in this disease.—*Multilocular cysts*, on the contrary, either from the consistence of their contents (firm jelly-like matter, ætheroma, acephalocysts, pilous and fatty substance,) or from the non-communication of their cells, rarely give rise to more than very obscure fluctuation, which may almost be confounded with the elastic doughiness of encephaloid; careful examination will, however, enable the observer to avoid this error.—It is not enough, however, to be able to affirm that the entire mass of the tumour is not composed of cancer—an extremely rare occurrence; we require to ascertain whether, and to what extent, encysted growths are complicated with carcinomatous deposition in their walls. In certain cases this may be done by the detection, both by palpation and percussion, of irregular indurated masses distinguished by their greater softness from the remainder of the tumour; when the cysts are exceedingly tense from thorough repletion with fluid, this sign of lobulation may not be ascertainable: in this state of things evacuation of the fluid by paracentesis will remove this difficulty in the way of the diagnosis. Nevertheless, the discovery of these lobulated masses is not a certain sign of cancerous formation; bunches of subcysts, with gelatinous or albuminous contents (we here allude to their outward appearance), aggregated in the parietes of larger cysts, give rise to a precisely similar sensation.—When the "hydatid fremitus" of M. Piorry exists in a marked manner, the presence of acephalocysts may be safely announced; but the recognition of this sign is far from easy.—A very rapid course of the disease furnishes one of the best proofs of encephaloid complication.

On the general principles of medical treatment of ovarian cancer, no particular point requires notice. It is important to remember that giving exit by puncture to the fluid contents of cysts of the ovary, complicated with encephaloid deposition in their walls, must, in the same manner as in the mamma, afford mischievous facility for the development of the cancerous matter. This distinctly appears to have been the result of the operation in a case related by Dr. Seymour[1]. A tumour of this kind was punctured with, as is usual, temporary amelioration of the symptoms; but the patient was subsequently unable to pass a month without a repetition of the process, "which each succeeding time became more difficult, from the *increase of the solid tumours* in the abdomen." It is impossible to separate the consideration either of paracentesis or extirpation in cancerous cases, and in those in which the ovarian tumour is uncomplicated with such disease; both these important operations are treated of in the article Ovary: under this head the bibliography of the subject will also be found. It may be right to anticipate our intended observations so far as to state, that if marked cancerous disease be present, the result of extirpation must, in the language of Dr. Bright, be " useless agony to the patient, and deep mortification to the operator."

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[1] Legallois, Bright, &c.

[2] Munro.

[3] On this Capuron, who considers the statement to be correct, observes: "Mais à quoi tient cette différence? Est-ce à une continence trop sévère, qui n'entre point dans les vues de la Nature, ou bien à la dissolution ou au dérèglement des mœurs qui n'a lieu que trop souvent hors du mariage?"

[1] Op. cit. p. 68.

(c.) Fallopian Tubes.—The Fallopian tubes are sometimes involved in carcinoma, spreading from the uterus. Boivin and Dugès have never seen them primarily affected ; Dr. R. Lee, however, affirms that the disease may originate in this situation.

(d.) Vagina.—The deep-seated portion of the vagina is, in rare instances, found to be the seat of cancerous disease, independently of extension from the uterus or rectum. Mr. Ferrall[1] recently exhibited a specimen of cancer, apparently of this kind, to the Pathological Society of Dublin. The vagina was the chief seat of ulceration, the uterus being healthy with the exception of the os tincæ, to which the ulcerative process had extended ; continuous with the cancerous surface was a large encephaloid tumour, which penetrated the roof of the vagina and entered the bladder, forming a large fungous mass in its interior. The patient died of exhaustion from repeated vaginal hæmorrhage.

(e.) Clitoris and Nymphæ.—These appendages may become the seat of cancer either primarily ; by continuity with deeply-seated parts ; or consecutively to the development of carcinoma of the uterus. Boivin and Dugès relate the case of a female, ætat. 34, in whom " the clitoris, of the size of the little finger, had acquired this volume from the serous infiltration of its external investment ; its proper tissue was scirrhous." Mr. Travers has also " known the clitoris the subject of scirrhous ulceration, and freely amputated."—Schoenfeld[2] removed the clitoris and nymphæ, forming a tumour weighing three ounces ; the mass was not of fibrous texture, but formed of a whitish substance, smooth, of almost cartilaginous hardness, and traversed by a multitude of capillaries visible under a lens. This was probably firm encephaloid. A tumour, consisting of a white softish clustered mass, as large as the clenched hand, was once found by Boivin and Dugès suspended to the clitoris and nymphæ, by a pedicle of the dimensions of the little finger. After death its component lobules were ascertained to possess the appearance and consistence of encephaloid. One of the most remarkable cases of this kind on record is described by Mr. Brayne[3]. The tumour in this instance weighed in situ (as nearly as could be ascertained) eleven pounds ; and its external appearance, the frequent and violent hæmorrhages and lancinating pains of which it was the seat, as well as the general course of the symptoms to which it gave rise, leave little doubt as to its carcinomatous nature, though, as the narrative does not extend to the patient's death, we are unaware of the precise characters of its component tissue. A very interesting example of carcinoma of the external genitals, which coexisted with pregnancy and with cancerous products in numerous other parts, has been related by Dr. Ashwell. Premature artificial labour was brought on in this case[1].

Excision of the diseased parts should be performed as early as possible. The dissection may, if necessary, be pursued as far as the insertion of the corpora cavernosa into the rami of the ischia.

(f.) Labia and Vulva.—Dr. Stedman[2] describes a tumour which had been growing for five years in the right labium of a woman of colour, was the seat of stinging pain and ulceration, and discharged a very fœtid matter. The patient was a good deal reduced. The growth was, on removal, ascertained to weigh twelve ounces and a half, and " to exhibit the true scirrhous character or section."

The skin of the vulva sometimes gives origin to cancerous excrescences, which run the same course as in other parts of the surface. In certain cases scirrhous infiltration of the skin is so trifling in extent that the disease appears to commence by ulceration. In this case, as Mr. Heming remarks, it is with difficulty distinguished from a venereal sore. " The chief diagnostic symptoms," says this practitioner, " may perhaps be found in the general affection of the surrounding sebaceous glands, giving the skin an appearance as if studded with tubercles, about the size of split peas." Inoculation of the secreted fluids might probably settle the question. In a case of this kind observed by Mr. Heming, " the carcinomatous affection had extended up the vagina to about two-thirds of its length ; the uterus and ovaria were not at all affected ; the liver had in its substance, particularly towards its surface, about twenty small tumours of a carcinomatous appearance, and both kidneys were affected with the same disease[3]."

The excision of the diseased parts is usually an operation of extreme simplicity, and, according to Bégin, the greater portion of the external genitals has been removed without entailing serious inconvenience or obstruction of function. But the presence of an intricate and extensive vascular plexus under the vaginal surface renders it a difficult matter in some cases to stop the hæmorrhage which follows : plugging the vagina with lint steeped in some styptic solution, and covering the external parts with compresses similarly imbibed—the whole being retained in situ with a T bandage—is the best mode of arresting it. The bladder should be regularly emptied with the catheter for some time.

Dr. Stedman encompassed the tumour above referred to with two semilunar incisions, and then rapidly dissected it out. Four small arterial branches only required to be tried; the wound was brought together with five stitches of interrupted suture. Five months after, there had been no return of the disease.

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[1] Dub. Journal, p. 335. Nov. 1839.

[2] L'Expérience, Sept. 5, 1838.

[3] Prov. Med. & Surg. Trans. vol. iv. p. 369. 1839.

[1] Guy's Hosp. Rep. vol. ii. p. 247.

[2] Ed. Med. & Surg. Journ. vol. xxxvii. p. 25.

[3] Translation of Boivin and Dugès on Diseases of the Uterus, p. 544. Lond. 1834.

XI.—*Urinary Organs and Passages.*

(A.) KIDNEYS.—Cancer of the kidney may be either primary or secondary; in the former instance solitary, or accompanied with scirrhus of the renal lymphatic glands and vessels, or with consecutive carcinoma in distant organs, especially the lungs. According to Rayer, the disease sometimes originates under the influence of, without continuity with, cancer of a neighbouring part, especially of the liver and of the descending colon.

Encephaloid is the species by far the most frequently observed in the kidney, and exhibits here its different varieties. The organ is sometimes divided into a number of compartments filled with cancerous detritus, blood, and pus arising from suppuration of their walls; these compartments may be without opening or communicate with the calices.

Of renal scirrhus Mr. Wilson has related a striking example: the tissue of the kidney was converted into "a substance nearly as solid as, and feeling like, softened cartilage, of brownish hue, and intersected by thin white membranous septa." König describes a similar case, and refers to another in the Ephemerides. M. Rayer has also met scirrhus thus situated, "with the same appearance as in mammary cancer," and surrounded with encephaloid pulp or in the neighbourhood of fibrinous deposits.

Encephaloid matter is found either infiltrated through the renal tissue or accumulated in masses; and, as it is affirmed, almost invariably appears first in the cortical substance, which may be totally destroyed before the tubular has suffered at all. The part of the kidney in which the morbid formation commences is subject to much variety. The masses may protrude into the pelvis, or push the membranous walls of that sac before them, and eventually perforate it: collections of the cancerous matter are frequently found in the renal veins and cavæ, either pure or combined with coagulated fibrine. In the early stages the size of the kidney is little affected; in proportion as the morbid matter accumulates, the gland undergoes corresponding enlargement. In the tuberiform species the intervening renal substance may be healthy, hyperhæmic, inflamed, infiltrated with or containing collections of pus. Both organs are very rarely affected; and we know of no instance in which both were extensively so. The healthy kidney is almost always hypertrophous; the non-cancerous parts of the diseased one are often in a similar condition.

The calices are sometimes obliterated, dilated and filled with serous fluid, as shown by Cruveilhier[1]; a state commonly resulting from pressure of the enlarged lymphatic glands of the hilus. The pelvis, in a case observed by Dr. Bright, was dilated into a huge cyst "containing two pints of a brownish fluid, like coagulated blood of long standing." The fibrous capsule may be exceedingly thickened; the hypertrophy bearing perhaps more particularly on the sub-fibrous cellular membrane described by Rayer[2]. This observer has never seen tuberculous associated with cancerous matter in the kidney; Cruveilhier's statements on this point have already been adverted to. The disease may coexist with renal calculi; in the case just mentioned of Dr. Bright, the pelvis contained a mulberry calculus.

In some instances heavy dull pain confined to the renal region is complained of, or this may be lancinating and shoot in the direction of the ureters or the bladder; in others the pain is rather referred to the anterior part of the abdomen, and none may be felt through the entire course of the disease. Various alterations in the conditions of the urine may be naturally supposed to attend its progress, but these have as yet been scarcely attended to. Hæmaturia, albuminuria, and purulent discharge with the urine have, however, been observed. The former is a symptom of almost invariable occurrence; in fact, we have not met with a single case recorded by writers, in which its absence is established; it may appear as the very first symptom, or supervene at an advanced period only, occur rarely, or be almost always present in abundance or in small quantity. Albuminuria may arise from the passage of encephaloid matter into the excretory passages[3]. When suppuration arises in the substance of the kidney and extends to the calices, or when there is distinct pyelitis (inflammation of the pelvis and calices; Rayer) pus finds its way into the bladder, and may be detected in the urine by the usual re-agents; this is, however, a mere epiphenomenon in the disease, and one more likely to mislead the practitioner than to assist him in its diagnosis. If the morbid deposition have materially enlarged the size of the organ, the resulting tumour may be detected by inspection, palpation, and percussion. Diarrhœa is a very ordinary attendant on the affection, and probably depends upon the irritation produced by the close proximity of the morbid formation to the ascending or descending colon. Œdema of the lower extremities is occasionally observed; when the vena cava is obstructed with cancerous matter, this is an invariable result.

Death sometimes appears to be the result of repeated hæmorrhage; in other instances it may follow rupture of the tumour from a blow, and consequent effusion of blood into the peritonæum[1]; but patients ordinarily sink gradually under the constitutional effects of the disease, though the peculiar cachexia is not often distinctly marked.

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[1] Livrais. i.

[2] Malad. des Reins, t. i. p. 23. 1839.

[3] Christison, Granular Degeneration of the Kidneys, p. 40.

The disease is more frequent in males than in females, as is the case with affections of the urinary system in general. M. Rayer has not met with it in children, and more commonly in persons of advanced age than in adults; Dr. Bright, however, speaks of "encephaloid disease of the most remarkable and rapid growth occurring in children of the most tender age."

We can do little more in this place than warn the student against certain errors of diagnosis, which a careless estimate of the symptoms we have enumerated might entail. Albuminuria is common to a multitude of affections, and a careful examination of the constitution of the urine in other respects is required to enable us to refer it to any one of these in particular. If it be accompanied with discharge of encephaloid pulp with the urine, distinguishable by its physical characters, there can be little hesitation as to the cause of the albuminous impregnation; and that it does not originate in the bladder may commonly be inferred from the absence of vesical symptoms, and the freedom with which the contents of that viscus are evacuated. Unfortunately however for the facility of diagnosis, patients have been known to suffer from hypogastric pain and other symptoms of diseased bladder, in whom after death this viscus was ascertained to be perfectly sound, while the kidneys presented various lesions, the existence of which had not, from the absence of local symptoms, been even suspected during life. For further particulars we must refer to the works of Dr. Bright, of M. Rayer, of M. Martin Solon[2], and of Dr. Christison.

In the writings of the two former authors, and in the chapter on examination of the kidneys by the ingenious and laborious Professor Piorry[3], may be found such directions, as the present state of the science admits of, for distinguishing the different kinds of renal tumours, and these from growths originating in other organs.

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(b.) Supra-Renal Capsules. The capsules are not unfrequently similarly affected when the kidney is cancerous; and the right one has been found to have become carcinomatous, apparently under the influence of heterologous growths in the liver. M. Rayer has never seen them affected except under these circumstances[4].

(c.) Calices, Pelvis, and Ureters. The excretory apparatus of the kidney is occasionally the seat of cancerous matter. 1. A cancerous growth in the kidney may protrude into these passages in the manner already described. 2. Liquiform cancerous matter effused from the kidney may be found occupying the pelvis and part of the ureter *in transitu* to the bladder. 3. Carcinomatous masses having no connexion with the renal disease may originate in the walls of the pelvis. In such cases the flow of urine secreted by the still healthy parts of the kidney is obstructed, and the walls of the pelvis present the columnar appearance so common in the bladder under analogous circumstances; a figure illustrating this has been given by M. Rayer[1]. The inferior extremities of the ureters are often affected in cancerous diseases of the bladder, either primary or consecutive to similar disorganization in the uterus; but we have met with no example of original development of this product in them.

(d.) Bladder. Carcinoma of the bladder is probably far from being so uncommon an affection, as the general statements of various writers would lead us to believe. Many growths included by writers under the vague term "fungus" seem to have been in reality, as attentive study of their anatomical characters and symptoms will show, either composed of purely encephaloid or scirrhous structure, or complicated with deposition of the former. Singularly enough, even the eminent M. Civiale, who inclines to the opinion here hazarded, contributes by his arrangement of vesical diseases to enforce the prevalent error; for he describes under the head "fungus" a case in which, in the language of the original observer, "the bladder contained four or five carcinomatous tumours of various sizes"; and another in which the morbid product was "pulpy, whitish, and cerebriform[2]." Formations which in the stomach, for example, would universally be recognised as cancerous, are from mere habit called fungi, when they exhibit themselves in the bladder. In these remarks we refer to primary cancer: of the frequency of the disease as a sequence of uterine carcinoma there is no doubt ever expressed.

Tuberiform or stratiform scirrhus are comparatively rare; but in a remarkable case detailed by Lallemand, "all the membranes were transformed into a lardaceous scirrhous substance, two inches thick behind the prostate, and extending two or three inches in every direction"; and Mr. S. Cooper has described a distinct example of scirrhous tumour of this organ occurring in a subject, in whom the femur of one side and a rib were infiltrated with the same morbid matter. Sir B. Brodie has never met with a tumour "wholly resembling scirrhus," but has occasionally observed part of a morbid growth to be thus constituted. Tuberiform encephaloid is the condition most commonly assumed by the disease, and here are exhibited the numerous varieties in point of vascularity, &c. elsewhere observed. The surface of the tumour may be smooth, especially before destruction of the mucous coat, irregularly tuberous or botryoidal; and the mass broad-based or pedunculated, studded with or encrusted with calculous substance,—or carcinomatous matter may, as in a case quoted from Ledran by Civiale, insinuate itself between the superficial asperities of a calculus.

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[1] Bright, case X.

[2] De l'Albuminurie. Paris, 1838.

[3] Traité de Diagnostic, t. 2, p. 326. 1837.

[4] L'Expérience, Nov. 10, 1837.

[1] Plate xlvi. fig. 3.

[2] Traité de l'Affection Calculeuse, pp. 322, 329. Paris, 1838.

The most common seat of cancer is the neck and its vicinity; it also springs from the fundus and anterior or posterior surfaces, but has very rarely been observed on the lateral aspects of the organ. The growth in some instances occupies a very considerable extent of surface; or cauliflower fungous masses, spreading from a narrow basis, may acquire great bulk (of both clenched hands in Desault's case), and almost completely fill the cavity of the viscus. The submucous cellular tunic is commonly the original nidus of the disease. There may be only a single or several tumours.

The mode of progress of the morbid growth is the same as in the other hollow viscera, but it is slow in ulcerating; a fact which has mainly served to keep alive the notion respecting the rarity of vesical cancer, already adverted to. The bladder itself is sometimes contracted, in other instances enlarged; its walls are commonly hypertrophous and exhibit the well-known columnar appearance; the mucous membrane is besides injected, thickened, mammillated, and softened—characteristics of cystitis. The prostate may be perfectly healthy; it was so in Lallemand's case, though immediately contiguous to the diseased formation. Abscesses in the cellular membrane of the adjacent parts sometimes hasten the patient's destruction.

Subjects affected with vesical cancer suffer from frequent inclination to void their urine, which may be passed in a small stream, or even *guttatim*, and from an uneasy sensation usually referred to the neck of the bladder, increasing after urine has been passed, occasionally becoming exceedingly severe, and shooting to the perinæum and along the urethra to the glans. In the cases observed by Desault and Lallemand there was fixed lancinating pain in the hypogastrium; while Chopart's patient referred his sufferings more particularly to the rectum. It is obvious that the effects of these growths on the excretion of the urine must vary with their precise dimensions and site: if seated close to the orifices of the ureters they may press on and dilate these ducts by causing an accumulation of urine within them (a state attended with almost complete retention), and give rise to pain and other symptoms of irritation in the kidneys; if the internal orifice of the urethra be partially obstructed, the urine is passed (and this is the more ordinary case) in the manner above described; if completely, either from the growing size of the tumour, or separation of pulpy detritus or clots of blood, temporary or persistent retention may arise; or if the growth be pedunculated and therefore partially moveable, a full stream may be suddenly and repeatedly arrested (as in a case observed by Velpeau[1]), before the contents of the bladder are on each occasion completely evacuated. The urine is usually turbid, and often contains that ropy matter commonly described as "catarrhal" or mucous, but which is now known to be pus modified in character by the action of ammonia[2]. Hæmaturia, in some cases constant, in others of rare occurrence, occasionally hastens the patient's death by its violence and pertinacity. Here, as in other organs, discharge of blood may be the first symptom of carcinoma; it has been observed by Sir B. Brodie before pain or micturition had been complained of. The same experienced surgeon states, that "the blood comes away in large clots of an irregular shape, in which small portions of medullary substance are not unfrequently *developed*." The growth may, as in two cases observed by Civiale, produce a distinct tumour in the hypogastrium. In one of these the cancerous disease coexisted with calculus, and as the former appeared "of inconsiderable size and stationary," it was believed to depend on thickening of the walls of the bladder; the patient underwent lithotomy and died: a cancerous mass sprang from the posterior aspect of the viscus. In the other instance, the presence of an irregularly rounded tuberous mass in the hypogastrium, combined with other local and general signs of cancerous disease, left no doubt as to the nature of the affection: the tumour, originating at the anterior surface of the viscus, had destroyed that portion of its walls, and contracted adhesions with the abdominal parietes. The destruction has in other instances gone further, the fungous mass protruding at the groin or pubis, or perforating the walls of the colon. The neighbouring parts are irritated by the presence of the foreign body, and defecation is frequently and with difficulty performed: where the growth has attained considerable bulk, it may, by pressing on the gut, entail obstinate constipation. The existence of a fungous carcinoma in the bladder predisposes, as all other causes interfering with the free excretion of the urine, to the formation of calculi.

Sir B. Brodie has known the disease run its course in eight or ten months, and seen it protracted during seven or eight years. Lallemand is of opinion that "lancinating pain behind the pubis, and emission of morsels of rotten fleshy matter" are the only symptoms by which cancer of the bladder may be recognised with any certainty. Other symptoms will, however, in many cases assist us in the diagnosis of this disease. Suppose there is bloody micturition, and that by the rules laid down in the article Hæmaturia, we have ascertained that the blood comes from the bladder,—if the discharge be exceedingly abundant, or if it occur without apparent cause, such as the jolting of horse or carriage exercise, or the operation of sounding, the inference is that it depends on cancerous rather than calculous disease. If the urine contain encephaloid detritus cognisable by its physical properties, doubt is of course at an end; or if it hold a small quantity only of this in suspension, the albuminous impregnation thus produced may be detected by the usual tests [1].

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[1] Médecine Opérat. t. iii. p. 696.

[2] See Brit. & For. Med. Rev. vol. viii. pp. 130 and 148.

We have further the evidence of catheterism to guide us in distinguishing the affection, but as past experience shows [2], the most skilful surgeons have not always been able to distinguish vesical tumours from calculi by this process. Although in some cases, from the extreme softness of the morbid growth, the distinction is comparatively easy, and in others, encephaloid pulp being carried away in the eye of the catheter, error actually impossible, yet in the majority of instances, if the tumour be firm, the sensations received by the operator are not so easily distinguishable from those produced by a calculus, as might, *à priori*, be supposed. In cases of this doubtful character mediate auscultation has been recommended, and as air is a better conductor of sound than water, previous inflation of the bladder suggested; but of the practical utility of this doubts may be entertained. M. Velpeau, and in this he is joined by Mr. Costello, would not trust to the evidence of the stethoscope, where simple catheterism left him undecided as to the nature of the disease. The difficulty of the diagnosis will be greatly increased if a calculus coexist with a cancerous tumour; and if the latter be encrusted with a thick layer of calculous matter (as in a specimen preserved in the Museum of the College of Surgeons, and described and figured by Dr. R. Willis [3]) there are no known means of ascertaining, during life, the nature of the nucleus of this unusual species of calculus.

In sounding or catheterising patients with vesical cancer there are two points to be borne especially in mind: first, that the morbid production sometimes pushes the posterior part of the bladder back, and thus increases to a remarkable extent the length of the prostatic portion of the urethra; secondly, that the introduction of the instrument is followed by much pain and often excites serious hæmorrhage. In illustration of the first point, which has also been noticed by M. Civiale, we may mention that Mr. Costello having on one occasion, as he informs us, provided himself with an unusually long catheter for the purpose of examining a patient affected with this disease, found it impossible, although he carried the instrument as far as practicable into the passages, to reach the posterior wall of the bladder.

Warner [1] long since showed the practicability of removing a tumour from the female bladder by ligature, when the meatus urinarius had previously undergone much dilatation: Lecat invented instruments for performing a similar operation on the male [2]; Covillard [3] cut a man for a tumour the size of a nut and squeezed it with forceps, after which it appears to have suppurated or sloughed away and the patient eventually recovered [4]: M. Civiale has succeeded with ease in removing "fungi," either by tearing them away or by breaking them down. But whatever may be the success of such operations in cases of polypoid vesicular, or erectile tumours, it is difficult to conceive how they could be otherwise than detrimental, where the morbid production is truly cancerous. In these latter cases palliative treatment alone seems warrantable.

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(e.) Urethra. 1. *Male.*—M. Lallemand's case of vesical cancer furnishes the only example we are acquainted with of carcinoma originating in the male urethra. The disease was not a prolongation or production from the morbid mass in the bladder, but "a cancerous tumour of the size of a nut situate at the posterior surface of the canal and behind the bulb." The investing mucous membrane was destroyed, probably by the caustic which had been employed to remove the stricture presumed to exist during life.

M. Lallemand sees no way by which such a tumour could be distinguished from an ordinary stricture, more especially when, as in this case, the patient had had blennorrhagia and been cured by the ordinary method of treatment.

2. *Female.*—The female urethra is sometimes the seat of cancerous disease either from the extension of adjacent carcinoma or independently of this. Of the former description, exhibiting itself in the areolar pultaceous variety, a striking example has been figured by M. Cruveilhier [5]. The walls of the canal in its entire length and circumference are here converted into a cylinder of that morbid structure, and communicate on the posterior

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[1] Rayer, Malad. des Reins, t. i. p. 184.

[2] Bédor, Lancette Franç. t. viii. no. 148. &c.

[3] On Urinary Diseases, p. 284.

[1] Phil. Trans. vol. xlvii. p. 414. 1749.

[2] Stacke, in Phil. Trans. vol. xlvii. p. 292., 1751.

[3] Observ. Iatrochirurgiques, p. 92. Strasb. 1791.

[4] Lettre à l'Acad. des Sciences, Dec. 22, 1834.

[5] Livr. xxiii. Pl. 6.

and inferior aspects with a similar cancer of the vagina and uterus. Amussat removed a fungous tumour from the orifice of the urethra of a woman who eventually perished from cerebriform cancer of the bladder; the anterior wall of the uterus is said to have appeared healthy, yet was destroyed by the contiguity of the vesical encephaloid, which was in the corresponding part softer than elsewhere [1]. Ulcerations of the orifice of the urethra occasionally become the seat of secondary cancerous deposit, independently of any similar disease in the rest of the genito-urinary system.

It seems probable that the cellulo-vascular tumour of the lip of the meatus, which is distinguished by its extreme sensibility from carcinomatous growths, may secondarily acquire a basis of scirrhus or become infiltrated with encephaloid matter.

When the urethral production coexists with deep seated disease, it is of course submitting the patient to unnecessary pain to attempt its removal. Under the contrary circumstances this may be effected with the knife; and the apprehension of excising part of the canal itself should not stay the hand of the operator, as cicatrization follows rapidly, and the shortened part continues to execute its functions satisfactorily. The only inconvenience to be expected from removing the meatus urinarius, as results from an examination of numerous cases by Dr. Hosack [2] is retention of urine. And this is the very opposite of a common occurrence, for two only among all the cases referred to by this writer were thus complicated,—one related by Mr. Hughes (1769) and the other by himself. In both instances this symptom disappeared spontaneously on the fifth or sixth days.

For Cancer of the Ear, Eye, and Orbit see these words.

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EXPLANATION OF THE ENGRAVED FIGURES.

PLATE I.

Diameter of the human blood globule = ·00025 *to* ·00030 *of a Paris inch (Müller).*

Fig. 1. *Nuclear cells and caudate corpuscula from an enormous medullary carcinoma taken from the abdomen of a female; the smallest cells measure* 0·00019, *the largest* 0·00095 *of a Paris inch in diameter.*

Fig. 2. *Nuclear cell-globules from a medullary fungus in the leg of a woman: they co-existed with caudate corpuscula.*

Fig. 3. *Elliptic corpuscules from an encephaloid mass of the foot and tarsus.*

Fig. 4. *Caudate corpuscules united into fasciculi: from a medullary fungus in the thigh of a child.*

Fig. 5. *Very irregular caudate bodies from a soft fungus of the female mamma: diagnosis doubtful.*

Fig. 6. *Caudate corpuscula, cells with nuclei and granules, magnified* 100 *diameters: from encephaloid of the liver.*

Fig. 7. *Caudate cells, some of them provided with a nucleus and nuclear corpuscula, from a soft juicy osteosarcoma of the lower jaw. The smaller diameter of these cells varies from* 0·00021 *to* 0·00050 *of a Paris inch. The substance of this sarcoma was in great measure albuminous, but it also furnished some gelatine, when boiled.* [*It appears to have been of a "benignant" kind, but the engraving exhibits the characters of these bodies as existing in encephaloid also.*]

Fig. 8. *Extremely tender fibres from a hyaline fasciculated carcinoma of the female mamma.*

Fig. 9. *Vessels with thickened walls and gaping on division, seen on a section of scirrhus of the mamma.*

Fig. 10. *Fibrous bed or stroma of macerated scirrhus of the mamma.*

Fig. 11. *Cell globules containing small corpuscula, magnified* 450 *times: from a carcinoma of the mamma.*

PLATE II.

Fig. 1. *Cell globules from another mammary carcinoma; some of them provided with granules, others with a larger nucleus-like granule.*

Fig. 2. *Cells with germinal cells and nuclei from an extremely hard ulcerated mammary scirrhus: diameter of the cells from* 0·00045 *to* 0·00119 *of a Paris inch.*

Fig. 3. *Meshes of fibrous fasciculi from reticular carcinoma of the breast, after removal of the cell globules.*

Fig. 4. *White granular corpuscules from the reticulum of a reticular carcinoma of the breast, magnified* 450 *times.*

Fig. 5. *Part of a delicate lamella of a reticular carcinoma of the female mamma, magnified* 100 *times and seen by transmitted light.*

Fig. 6. *Cells of alveolar cancer* [*colloid*] *of the stomach, magnified* 100 *times.*

Fig. 7. *Still smaller and the smallest cells of the same specimen, magnified* 450 *times.*

Fig. 8. *Large cells of alveolar carcinoma with fibrous walls, filled with jelly and probably produced by accretion of the smaller cells. It must, however, be remarked that the conversion of the small cells into these large ones with fibrous walls is not directly observed, and that the fibrous condition might also depend on the development of a tissue between the beds of cells,—which tissue would be the stroma for the cellular formations.*

CANCRUM ORIS, *Wasserkrebs, Mundkrebs, Mundfaüle, faulige Mundhölenerweichung, Kinderbrand*, Ger.; *Waterkankir*, Dutch; *Cancer aquaticus, Cancrum oris, Gangrena oris, Noma, Stomacace*, Lat.; *Affection gangréneuse de la bouche, Gangrène de la bouche, Stomatite gangréneuse*, Fr. Cancrum oris, or, more properly, gangrene of the mouth, in children, is an affection analogous in many respects to hospital gangrene. We do not find any account of the disease in ancient writers, but in modern times it has been, more or less perfectly, described by Van Swieten, Underwood, Sauvages, Dease, Baron, Cumin, Isnard, Marshall Hall, Taupin, Webb, Richter, and other German writers. Amongst these, the only authors who have given a detailed and accurate history of gangrene of the mouth are Cumin, Richter, and Taupin.

Dr. Cumin distinguishes three forms or varieties of gangrena oris. The first variety commonly occurs in infants at the breast. The upper gums are always attacked first, and present a purplish and spongy appearance; the roof of the mouth, also, being of a purplish colour. Ulceration now soon takes place; the surface of the ulcer is greenish or ash-coloured, and much disposed to bleed: the secretion of saliva is increased, and the bowels are generally constipated.

The second form usually occurs in children who have been enfeebled by some previous disease. Here the ulceration is generally confined to one side of the mouth, but may extend to the neighbouring parts; the tongue (according to Dr. Cumin) takes on a similar action, and is either wholly or partially destroyed. The third variety is principally confined to the cheek and lips; it commences with ulceration of the lining membrane of those parts, soon afterwards followed by a hard, red, shining and circumscribed swelling, which quickly becomes gangrenous. This form resembles the gangrenous inflammation of the pudendum described by Kinder Wood; in the second variety, ulceration is predominant: in this one, gangrene.

Richter likewise divides gangrene of the mouth into three species; viz. the scorbutic, the gastric, and the metastatic. The first variety seems be nothing more than a severe degree of scurvy, and should be separated from the disease now under consideration. It commences with tumefaction of the gums, which are of a livid colour, and bleed readily; the secretion of saliva is increased; the gums become detached from the alveolar processes, and the teeth are loosed. These local symptoms are usually accompanied by some fever, particularly towards evening, and by diarrhœa; when they have continued for a time which is very indefinite (varying from a few days to some months), gray or lead-coloured spots are perceived upon the gums; these spread, assume a gangrenous appearance, and soon involve the whole of the gums, the lips, and the cheeks. In some cases the maxillary bones are attacked, and portions of them are destroyed. The fever now assumes a low, nervous type, the child's strength is exhausted, and death ensues in from eight to fourteen days after the commencement of gangrene. For the treatment of this form of gangrene of the mouth Richter recommends the use of mineral acids, in conjunction with mild tonics, and occasionally bark, camphor, or wine. The local remedies are the same as those employed in the other varieties.

The gastric form is rare; it is preceded by symptoms of gastric disorder, viz., nausea, vomiting, diarrhœa, loss of appetite, aphthæ, &c. The disease begins in the mucous tissue of the cheeks or angle of the mouth by a small discoloured vesicle, which soon passes into a round, foul ulcer, with red circumscribed edges. The gangrenous ulcer extends, and in a few days there appears on the cheek an ash-coloured livid spot, which gradually spreads in all directions, embracing the cheeks, lips, nose, and walls of the mouth. As the disease advances the gastric symptoms increase, and the child dies in a state of extreme prostration; the intellectual functions, however, usually remain undisturbed to the last.

The metastatic variety of cancrum oris is that which supervenes on acute exanthematous disorders. It appears suddenly, with few or no premonitory symptoms; a small hard tumour forms on the inner surface of the cheeks; in two or three days the tumour increases, is harder and more red; the inner surface of the cheek assumes a gangrenous appearance, and the breath is extremely fœtid. The external surface of the cheek now becomes tumid, shining, and sometimes red; and as the gangrene spreads, the colour gradually changes to a dirty black, indicating the extension of the disease to the skin. The gums, opposite the gangrenous parts, are also involved, but this, according to Richter, is always a secondary occurrence.

M. Taupin, who has written the most recent and the best memoir on gangrene of the mouth in children, divides the affection into three forms, the pseudo-membranous (*couenneuse*), the ulcerative, and the dry (*charbonneuse*). As we have not observed ourselves with sufficient accuracy the first form, we shall give an abridged account of it from M. Taupin, and then pass to a consideration of the other two forms.

Pseudo-membranous form.—This form corresponds with the scorbutic variety of Richter, and occurs as a complication of some scorbutic affection. It generally commences on the gums, and never exists on the tongue or roof of the mouth. At the earliest stage of the disease the gums are observed to be tumid, red, soft, and fungous; afterwards they are of a purplish colour, and bleed at the least touch; the teeth are loose; this state may continue for an indefinite time, but if neglected, it frequently passes into that of gangrene. The gums are now covered with a greyish and fœtid exudation, which is reproduced as fast as it is removed; on examining them closely they are seen to be of a purplish red colour, and present an unequal fungous appearance, with partial and slight ulceration of the mucous tissue. In this state they may continue for a length of time, but should gangrene supervene, the gums become black, and are detatched in soft putrid masses, together with the teeth and portions of the alveolar processes. The pseudo-membranous form of gangrene may, also, commence at any point of the parietes of the mouth. In such case we first observe a number of small pale yellow spots, situate in the mucous tissue, with some tumefaction and redness of the intervening mucous membrane. A whitish exudation is now thrown out by the affected parts, and soon afterwards, on removing it, we discover some small ulcers underneath. These ulcers unite, and the false membrane is reproduced for a few days in such quantity that the diseased points are elevated above the surrounding surface, and the ulcers completely concealed by the pseudo-membranous exudation. At this stage the disease may remain stationary, may pass into gangrene, or is susceptible of cure. In the latter case the exudation gradually ceases, the tumefaction subsides, and the loss of substance is repaired, within fifteen days, by granulation. Should the disease, on the other hand, progress, the ulcers assume a gangrenous appearance, and the cheeks, lips, with other parts of the mouth are successively destroyed in the manner which shall presently be described, the pseudo-membranous passing into the dry form of gangrene.

The ulcerative form.—This appears to be the form which was observed by Isnard[1] and more recently by Drs. Webb[2] and R. Willis[3]. According to Richter the ulcerative variety always commences on the mucous membrane of the mouth or lips, but we have seen it occupying every point of the interior of the mouth. There is, however, much difficulty in ascertaining the precise manner or place in which the disease begins. The early symptoms are frequently mild, and the attention of the medical man is rarely directed to them before the gangrenous ulceration has already made some progress. M. Isnard describes the disease as commencing by a small, whitish, superficial ulcer, with irregular edges, on the mucous membrane of the mouth or lips. As the ulcer extends it assumes a dirty gray appearance, and is covered by a tenacious, purulent exudation. The breath now conveys a very fœtid odour and the cheek begins to swell. According to Richter, we first perceive, on the lining membrane of the cheek or lips, one or more vesicles of unhealthy aspect, which break in a few days and are succeeded by a malignant ulcer, or by a dark pustule surrounded by a well-defined inflammatory circle. Were we to speak from our own experience we should say that the ulcer commences most frequently on the gums, or at the junction between the gums and lining membrane of the cheek. The appearance of the neighbouring parts varies in different cases, and it seems probable that the differences which exist in the descriptions of many writers, depend on their having drawn general conclusions from a limited number of cases. Sometimes the tissue of the gums is spongy, red, or of a livid colour; in other cases the ulcer is preceded by inflammation, or more commonly by irritation of the affected points; in others, again, the ulcerative form has succeeded to the pseudo-membranous, and at an early stage it is impossible to determine what will be the result of the primitive lesions. When once formed, the character of the ulcer is peculiar: the edges are ragged, and the bottom is covered by a dirty brown or grey eschar, which is occasionally detached and renewed according to the progress of the disease. It is impossible to fix, with any degree of certainty, the duration of this form of gangrene of the mouth. It is sometimes rapid in its progress, and soon destroys the whole of the gums, or extends to the lips, cheeks, periosteum of the maxillary bones, &c.; but when properly treated it usually terminates in a cure, as our own experience, confirmed by that of Dr. Willis and Dr. Webb, testifies. In many cases, however, the ulcerative variety is complicated by the supervention of the dry form *(forme charbonneuse)* and then sets in a train of symptoms of the most dangerous and formidable nature. These constitute gangrene of the mouth, properly so called, and it might admit of question whether the other two varieties might not with propriety be separated from it altogether.

The dry[1] *form.*—As we have already remarked, this form frequently supervenes on the other two, changing their character and rendering them highly dangerous and destructive. It may also commence by a small brown slough on the inner surface of the cheek; or finally (according to M. Taupin), by mortification of the cellular tissue and soft parts contained between the skin and mucous lining of the cheek.

The latter (primary) is the most intractable species and almost invariably terminates in death. It usually occurs in debilitated subjects of scrofulous or cachectic habits, and as a complication of the acute exanthemata, hooping-cough, or fever. The development of the disease is indicated by a tumefaction of the cheek, which is pale and sometimes shining, but unaccompanied by pain or other symptoms of inflammation; the surrounding tissues, particularly the lower eyelid, are œdematous. The colour of the swollen parts soon changes; sometimes the surface of the tumours is reddish, at others of a dirty yellow; the colour rapidly changes to black; a slough is detached from the inside of the cheek, and the discoloured parts are rapidly destroyed by mortification. The extent of destruction seems to depend upon causes which we are unable to appreciate; the nature of the previous exanthema and the duration of the disease, however, exert a certain degree of influence. Sometimes the child perishes before any considerable portion of the cheek had been destroyed; at other times the gangrene extends from the cheek to the gums, which are successively detached in putrid eschars; the teeth fall out, one after another; the periosteum is removed from the maxillary bones, which are covered with a dark layer, and in some cases necrosed; the lips and nose may likewise be totally destroyed and nothing remain of the face except the forehead, eyes and chin. We have recently seen an example of the extensive mortification of the face just described. It occurred in a poor child, living in a most unhealthy locality and convalescent from measles. The nose, lips, and greater part of the cheeks had been destroyed by the dry form of gangrene, yet the unfortunate sufferer continued to seek its mother's breast to within a few hours of death.

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[1] Thesis. No. 188. Paris, 1818.

[2] Medical Examiner, Philadelphia, No. 35. 1839.

[3] Illustrations of Cutaneous Diseases, London, 1840.

[1] The term *dry* does not express exactly the nature of this form, but I have not been able to select a more appropriate one.

The *secondary* species of dry gangrene is that which supervenes on the ulcerative; it is the species which we have observed most frequently at the children's hospital, Paris. In some cases the mucous tissue of the gums or cheek has scarcely become ulcerated when mortification or phagedenic sloughs succeed; in other cases the primitive form remains stationary for some time before the ulcers assume a gangrenous aspect and the disease begins to spread with its characteristic rapidity. The appearances are nearly the same as those which attend the first (or spontaneous) species. The gums, or lining membrane of the cheeks, at the parts occupied by the ulcers and in their vicinity, become black and are detached in the form of putrid detritus. The breath now conveys an intolerable odour, the salivary glands are often enlarged, and saliva, sometimes mixed with blood, is discharged from the mouth in great quantities. On about the third day after the appearance of the ulcer in the mouth the cheek begins to swell, in consequence of the infiltration of yellowish serum into the cellular tissue, and the tumefaction gradually but slowly extends. The external aspect of the cheek varies in different cases. The external surface is sometimes pale and shining at first; sometimes of a dirty straw colour, sometimes hot, red and painful; finally, at other times of a violet tinge, more or less marked from the commencement. We have seen these different appearances of the cheek, and in a few rare cases have observed death to ensue before any change had taken place in the external aspect of the cheek. The peculiar tumefaction and appearance of the cheek are, however, a sure indication of the existence of gangrene, and if the medical attendant have overlooked the other symptoms, he cannot fail to be arrested by this one. Whatever may have been the colour of the tumid cheek, it soon begins to assume a livid hue, which gradually becomes black; the whole thickness of the cheek is now destroyed by mortification, and if the child survive for a few days the eschar may be detached, leaving an enormous loss of substance in the walls of the mouth. The gangrene and tumefaction of the cheek are, as far as our own experience goes, always confined at first to one side of the face; but in two or three days a brown fetid eschar frequently forms on the corresponding point of the cheek opposite to the one attacked, and the same train of symptoms follow. Instead of terminating in death, as it commonly does, the gangrene may sometimes be arrested and a cure obtained. The first symptom indicative of a change for the better is the formation of a red circumscribed line around the dark-coloured spot, or gangrenous perforation of the soft parts; the tumefaction begins to subside; if the hard parts have been involved, portions of the maxillary bones are detached, granulations spring up from the neighbouring healthy tissues; they contract, cicatrize, and present irregular surfaces similar to those produced by extensive burns.

Symptoms.—We have hitherto described only the local appearances and progress of cancrum oris. The general symptoms seldom bear any proportion to the extent or severity of the local disease. In many cases the gangrenous destruction of the gums and mucous lining of the mouth is not preceded by any manifest disturbance of the economy. When it occurs as a complication of the acute exanthemata, again, the symptoms which pertain to the local affection are masked by those of the eruptive disorder. Sometimes, however, the following premonitory symptoms have been noticed from eight to fourteen days before the commencement of ulceration in the mouth; the child is dull and uneasy, and the sleep is often disturbed or broken; the appetite is lost; the tongue foul; the secretion of saliva is augmented, and the salivary glands are often enlarged; the bowels are commonly loose; the stools fœtid, and the child complains of constant thirst; a febrile access generally occurs towards evening. The formation of a gangrenous spot is always accompanied by two local symptoms, to which the attention of the surgeon should be immediately directed; these are a peculiar fœtid and metallic odour of the breath and an increased secretion, occasionally mixed with blood, from the salivary glands. Whenever either of these two symptoms occur during the course of, or convalescence from an acute exanthema, &c. or in debilitated unhealthy children, the surgeon should at once make a careful examination of the mouth and gums, for although the fœtid breath shows that gangrenous ulceration has already commenced, yet the affection may be arrested by judicious treatment in the early stage, whereas it is intractable when the sloughing process is once fully established. Tumefaction of the submaxillary gland is another symptom which accompanies the development of cancrum oris. M. Guersent thinks that it is of very frequent occurrence, but the more careful and accurate observations of M. Taupin[1] show that much importance should not be attached to a symptom which occurs in only one-sixth of the cases, and often depends rather on some constitutional cause than on the local affection. In proportion as the gangrene progresses, the general symptoms become more manifest, although sometimes the child dies before we can perceive any well marked derangement of the economy, save a gradual sinking. Febrile accesses rarely occur, but the pulse is quick, and small, and weak. The skin gets cold, the bowels are relaxed, the stools fœtid; the child lies in a state of stupor; the vital powers are exceedingly depressed; gangrenous sloughs (analogous to those of the face) occasionally form in other parts of the body (particularly on the pudenda in females), and the patient sinks at last, exhausted by diarrhœa and by the progress of the gangrene.

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[1] In eighteen out of one hundred and seven cases. In twenty fatal cases of dry gangrene of the cheek, of which I have preserved records, the tumefaction of the submaxillary gland is only noted twice.

Causes.—This disease may be said to be peculiar to children, for the examples which have been observed in the adult are extremely rare. In a total of 1900 cases attended by M. Taupin at the Hôtel-Dieu in the year 1837, only one case of gangrene of the mouth, affecting an adult, presented itself to him. The particular age at which it prevails most is differently stated by authors. The Germans say between the ages of two and eight, inclusive; according to M. Taupin, from five to ten; according to Richter, from two to four years[1]. It rarely occurs in children at the breast. Boys appear to be affected much more frequently than girls; the proportion established by our own researches at the Children's Hospital being as five of the former to two of the latter. The season of the year also exercises some influence on the development of the disease; it is more frequent during spring and autumn than in winter, and rarely occurs during summer; cold and moisture combined are the atmospheric influences which seem to act chiefly as predisposing causes. M. Taupin has not been able to discover that children brought up to any particular profession are more subject than others to gangrenous affections of the mouth. The disease sometimes occurs in healthy, robust, children, but it is then, usually, the result of some irritating cause, such as carious teeth, a burn or other injury of the mouth; in the vast majority of cases it affects weakly, ill-fed children, who have been subject for some length of time to the action of debilitating causes. Amongst the chief of the latter we may reckon the imperfect nutriment of the children of poor parents, and the vitiated atmosphere in which they constantly live; hence we find that nine-tenths of the cases are furnished from the poorer orders of society. As general debility of the system is the chief predisposing element of gangrena oris, the disease frequently presents itself as a complication or sequela of certain disorders accompanied by debility; in children convalescent from lingering disease, where an antiphlogistic treatment has been vigorously pursued, and finally, after the acute exanthemata or other diseases of the skin. The practice of the Children's Hospital, Paris, shows how much the development of this disease is favoured by any thing which debilitates the constitution of the child. M. Taupin informs us that gangrena oris rarely complicates tinea, when the latter is treated in the usual way, but that it often occurs in children submitted to the debilitating treatment of the Frères Mahrons[1]. Towards the end of typhus fever, gangrene of the mouth occasionally occurs, and also in children long subject to diarrhœa or other chronic affections of the intestinal canal, but from some peculiarity which we are unable to explain, it very rarely attends pulmonary consumption, even in its last stage.

All writers have observed the remarkable connexion that exists between gangrene of the mouth and the acute exanthemata. It is not, however, true, as many authors state, that the development of the disease is favoured by irregularity, metastasis, or retrocession of the eruption. The gangrene as often attacks children labouring under a mild exanthema, as those cut down by the more acute forms, and more frequently during the convalescence, than while the eruption is out. Amongst the acute exanthemata, measles takes, by far, the lead as a predisposing cause: none of our writers have attempted to account for this well-known fact; but I would venture to suggest that it is, in some measure, connected with the pneumonia which attends measles more frequently than any other febrile exanthema. After measles comes small-pox, then scarlatina, hooping-cough, typhoid fever, and darterous affections[2]. M. Taupin has frequently seen gangrena oris in children affected with anasarca after scarlatina, and remarks (an observation with which my own experience fully concurs) that it never supervenes in the course of acute cerebral affections, to which children are so much subject. I do not remember to have seen a single example of the disease accompanying tubercle of the brain, although in many cases the child affected with cerebral tubercle dies in the last degree of marasmus and debility. These are peculiarities which the present state of our knowledge does not enable us to explain.

A question of much importance, not only in a medical, but in a medico-legal point of view, presents itself here in connexion with the causes of gangrena oris. Is the disease ever produced by mercury? Is the irritation of the mucous lining of the mouth, which accompanies salivation, apt to terminate in gangrena oris? To these questions we would answer, 1st, that sloughing ulceration of the mouth may, certainly, follow excessive salivation; but, 2nd, that the destructive process pro-

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[1] In twenty fatal cases of the dry form, which we observed at the Children's Hospital, Paris, the following was the proportion of ages:—

Age	No. of Cases.	Age	No. of Cases.
3	9	8	1
4	5	9	1
5	1	10	2
7	9		

[1] These gentlemen are authorized by the French government to treat all cases of tinea in the Parisian hospitals.

[2] In twenty cases of gangrene of the mouth there occurred with or after measles, seven cases; small-pox, four; scarlatina and measles mixed, two; scarlatina and small-pox, one; scarlatina, one; varicella, one; lichen, one; typhoid fever, one; tubercular peritonitis, one; indeterminate affection, one.

duced by mercury is quite different from true gangrena oris, and should never be confounded with it. These points belong more properly to the subject of diagnosis, but we shall discuss them here. Although we have seen a vast number of cases of gangrena oris, we have never seen it developed as a consequence of the action of mercury ; indeed few of the children affected had taken a single grain of mercury during their treatment in hospital. M. Taupin, who followed more than 200 cases during his residence at the Children's Hospital, tells us that he, also, has never seen the ulcerations produced by mercury or tartar emetic terminate in gangrene. When tartar emetic is employed in high doses, after the Italian method, it often gives rise to ulceration of the mucous tissues of the mouth with salivation, but the ulcers heal quickly, and never assume the form of gangrena oris, even in debilitated subjects. It must, however, be admitted that many of the symptoms of the scorbutic form of gangrenous sore mouth resemble those which accompany excessive salivation. Dr. Webb says[1], " at this stage it closely resembled ptyalism ; indeed, so close is the resemblance, that it is almost impossible to distinguish the one from the other ; but in this disease there was not that great increased secretion of saliva which almost always accompanies salivation." Dr. Coates tells us that Dr. Parrish for several years in his private lectures noticed a stage of this disease, under the name of " a disease resembling the effects of mercury[2]." Notwithstanding the opinion of Dr. Webb, we feel convinced that by proper care the true gangrenous sore mouth, such as it has been already described, may be distinguished from the effects of mercury. There are few cases on record of death following extensive destruction of the mouth in children after the administration of mercury ; but a very valuable one is contained in the Lancet[3]. A child, three years old, being affected with fever, was placed under the care of a young medical gentleman. Twelve white powders were prescribed, to be taken within twenty-four hours. After taking them the child's face became swollen, abundant salivation ensued, and the breath was very offensive. Inflammation soon extended to the whole of the gums, and some of the teeth fell out. On the third day after the administration of the powders, a small black spot appeared between the lower lip and chin ; this rapidly extended, and on the fifth day, nearly the whole of the lower lip was destroyed, while the adjacent skin, including that of the upper lip, was of a dusky red colour, becoming lighter towards the external margin of the phlegmonous circle. The child sank rapidly, and died in a state of prostration. On examining the body, the *whole of the gums in both jaws were* found to have been *destroyed;* and in addition to extensive sloughing of the soft parts in the mouth, a line's thickness of the muscles, forming the root of the tongue, was destroyed. The epiglottis round its edges presented a vivid red tint, and all the salivary glands were tumefied.

This instructive case enables us to compare the effects of mercury on the gums and mouth with gangrena oris, and to establish the differences which exist between the two affections. In gangrene of the mouth the salivation is not very profuse at first, and always takes place after the formation of the gangrenous ulcer or spot ; the odour of the breath is different from that which is occasioned by mercury : if we examine, carefully, the interior of the mouth (and this is particularly manifest after death), the gums, tongue, and mucous membrane are free from any marks of irritation or inflammation, except in the immediate vicinity of the points affected by gangrene. In many cases we have observed, after death, that the healthy portions of the gums were even more pale than is natural ; tumefaction of the salivary glands occurs in a small proportion of cases only, and then takes place as a secondary lesion. In destruction of the mouth from excessive doses of mercury, the *whole* of the gums, with the salivary glands, exhibit marks of excessive irritation or inflammation, for some time *before* the development of the process, which resembles more sloughing phagedena than true gangrene. The interior of the mouth is red, the tongue swollen, and profuse salivation sets in *before* the occurrence of the slough. The peculiar mercurial odour also precedes the destructive process ; in gangrene of the mouth it is not perceived until ulceration or gangrene has commenced. Finally, in the dry form of gangrene, or in that which commonly terminates existence, the tongue is never involved ; while in the mercurial case, which has been already noticed, we find " that a line in thickness of the muscles, forming the root of the tongue, was destroyed ; the edges of the epiglottis were red, and all the salivary glands were tumefied."

Amongst the causes of gangrena oris we must not omit contagion. Richter confesses that he cannot form any opinion upon this point, but M. Taupin affirms, in the most positive manner, that he has seen the pseudo-membranous and ulcerative forms communicated from one child to another, by the use of the same spoon, glass, &c. ; the dry form, however, he has never observed to be communicated by contagion, perhaps because more precautions were used to avoid uncleanliness.

Diagnosis.—The distinctions between gangrene of the mouth and sloughing from the effects of mercury have been already pointed out ; there are but few other affections to which it bears any similarity. At an early stage it may resemble aphthæ; but the latter occur chiefly in infants at the breast; they are accompanied by general symptoms, different from those of gangrena oris: when eschars form, they are generally superficial, confined to the mucous tissue, and of a brown rather than black colour; the lesions, discovered after death from the two diseases, are also quite different. Malignant pustule commences on the skin of the cheek, and proceeds from without inwards: finally, common inflammatory tumefaction of the cheek, occasioned by a carious tooth, may present, at first, some similarity to the early stage of gangrene, but is soon distinguished from it in its progress.

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[1] Med. Exam. No. 35. p. 1.

[2] Dr. Cumin, also, notices the analogy between gangrena oris and the gangrenous destruction occasionally produced by mercury. In a case of hydrocephalus he gave large doses of that mineral ; in a few days a foul ulcer appeared on the inside of the cheek, and soon involved the parts in gangrene. Dr. Troschel has written some interesting observations on the same subject in the Medic. Zeitung, No. 35, 1838.

[3] Vol. ii. p. 158. 1831-32.

Prognosis.— Almost all writers on this disease agree in thinking that it is extremely dangerous, and generally terminates in death, on the fifth to the fourteenth day after the development of the disease. We are not able to point out with much certainty the circumstances which render gangrena oris more or less destructive or fatal: a few points, however, seem to be determined by experience. In very young children the disease is more fatal than when it attacks those of from four to seven years of age; for the former are, commonly speaking, weaker, more subject to the development of thoracic affections, and in them the dry form prevails over the ulcerative or pseudo-membranous. The strength of the little patient, his constitution, previous mode of life, locality of habitation, &c. must also influence the gravity and progress of the complaint, although it be difficult to ascertain the precise effect of each predisposing agent. The form which the gangrene may assume is the most important element; the dry form, especially its spontaneous variety, is extremely fatal; indeed, almost always terminates in death. Thirty-six cases observed by Mr. Taupin were all fatal. I possess myself twenty observations of this form; all the children who were attacked perished: the pseudo-membranous form, on the other hand, is a mild disease, and the ulcerative very frequently admits of a cure. The cases observed by Dr. Webb, at the Children's Asylum, Philadelphia, seem to have been of this kind; for of twenty-three, nineteen recovered, and four only proved fatal. It is probable that the cases treated by Dr. Willis, at the Royal Infirmary for Children, also belonged to the ulcerative form of gangrena oris, although the example depicted in his excellent work on cutaneous diseases is one of dry or sphacelating gangrene. Dr. Willis saw only one fatal case in more than twenty, but says that if the gangrenous affection extend to the cheek, nineteen out of twenty patients will perish.

Complications.—The two first forms of gangrena oris being comparatively mild, are seldom complicated by any serious lesion of the internal organs; but with the dry form, whether it occurs spontaneously or supervenes on the other two, we very frequently find acute disease of the thoracic viscera. Many years ago I pointed out the remarkable coincidence which exists between gangrene of the mouth and inflammation of the lungs; M. Taupin has more recently drawn attention to the same fact. In thirty-six fatal cases M. Taupin assures us that he has found marks of acute disease, always confined to one side of the chest; viz. inflammation of the lung in twenty-eight cases (in seventeen of these, corresponding sides of the face and chest were affected), pleurisy in four cases, and in four gangrene of the lung. In four cases, together with pneumonia, he observed a gangrenous destruction of the mucous membrane, which lines the pharynx, œsophagus, and a portion of the stomach; and in three cases, an inflammatory softening of the large intestines. My own experience fully supports the correctness of M. Taupin's observation, with this slight exception, that I have not invariably found inflammation of the lung in fatal cases of the dry form of gangrena oris. In two cases it was represented by tubercular excavations, without hepatization; in one by effusion of serum, but I always found that one side of the chest only (in a majority of cases corresponding with the affected side of the face) was inflamed. Here an interesting question presents itself for inquiry: what connexion is there between the thoracic disease and the gangrene of the mouth? does the former depend on the latter, or is the gangrene rather dependent on or influenced by the inflammatory affection of the chest? I have paid considerable attention to these important points, but must confess myself unable to solve them at present.

The following analysis of ten cases, eight of which are published in a weekly journal, may serve in the mean time to throw some light on the question. In the first case symptoms of pneumonia manifested themselves seven days before the appearance of gangrene of the mouth; the constitutional effects were severe, the pulse ranging from 140 to 156, and the respiration continuing above 70; the child survived ten days; after death extensive gangrene of the mouth was found to exist with hepatization of a small portion of the right lung. In the second case, also, pneumonia preceded the gangrena oris, by three or four days: the child lived for eleven days after the first appearance of gangrene; here the destruction of the mouth was greater than in the former case, but only a few nodules of lobular pneumonia were found in the left lung. In the third case the circulation and respiration were not much disturbed; the patient sunk on the twelfth day, and nothing was found in the chest except extensive adhesion of one lung to the sides of the chest. The fourth child was brought to the hospital in the last stage, and it was impossible to ascertain how long the inflammation of the chest had existed; it occupied, however, a greater portion of the lung than in any former case, although the gangrene of the mouth was not very extensive.

In the fifth case the pulmonary symptoms preceded the development of gangrene, which had not destroyed the whole thickness of the cheek, yet after death the inferior half of one lung was found in a state of hepatization. In the sixth and seventh cases the gangrenous destruction of the mouth was superficial; there were no symptoms of pneumonia during life, and after death nothing was found in the chest except small tubercular cavities in the lungs. In the eighth case the child had laboured under symptoms of chronic pneumonia for some time, when the mouth became affected; he died just as the gangrene was extending to the cheek; both inferior lobes of the lung were found in a state of red hepatization; yet the symptoms during life, were far from indicating such an extensive lesion of the thoracic viscera. The ninth case was that of a child debilitated by scarlatina and labouring under anasarca; the gangrenous affection had destroyed all the gums and a great part of the inner wall of the right cheek; there was no inflammation of the pulmonary tissue, but both pleuræ and the pericardium contained a quantity of serum. The subject of the tenth case was a girl, seven years of age, who laboured under typhoid fever; eighteen days before death symptoms of severe pneumonia set in, and in thirteen days were followed by those of gangrene of the mouth, which did not extend beyond the gums and lower lip; after death both inferior lobes of the lung were found extensively hepatized. The only practical conclusion which the preceding observations entitle us to draw is that the pneumonia always preceded the gangrenous destruction of the mouth; but we cannot discover any relation between the intensity or extent of the two affections. The pulmonary symptoms were often masked by the local disease; they were seldom very severe, and do not seem to have exercised any well-marked influence in hastening its progress or rendering the destruction of the face more extensive.

Gangrena oris is sometimes complicated with an analogous affection of other parts of the body. We have already mentioned gangrene of the lungs. In one remarkable case observed by the writer, there occurred in the arm, under the pectoral muscle, and on the calf of the leg, tumefactions exactly similar to that of the cheek, but the child sank before they passed into actual gangrene; when examined after death the swollen parts presented the peculiar appearances of the cellular tissue which surrounded the mortified portion of the cheek. In girls, gangrene of the pudenda sometimes accompanies that of the mouth. The other complications will be noticed under the following head.

Pathological anatomy.— The lesions produced by gangrena oris are found in all parts of the cavity of the mouth, but there is some variety according to the form of the disease and its primary seat. The pseudo-membranous form is usually confined to the gums, and never occupies the tongue or roof of the mouth; the ulceration may exist at any point of the buccal cavity, but chiefly occupies the gums: the dry form almost always commences at the middle of either cheek[1]; sometimes on one of the lips (especially the lower one) but never on the tongue. The original seat of the lesion also occasions some slight differences of appearance; when it commences on the gums, the latter are found covered with a whitish, pulpy, exudation, underneath which the tissue of the gum is tumid and soft; at a later stage the tissue is reduced to a black, fœtid pulp, which is detached with the greatest facility, leaving the alveolar processes underneath exposed, black, and sometimes necrosed. On the soft parietes of the mouth the first degree of gangrenous destruction consists in the formation of small yellowish points, resembling aphthæ, underneath which are concealed small irregular ulcerations. The next stage differs according to the form which the disease may have assumed. If it be the pseudo-membranous, then the ulcerations are covered by a yellow, irregular, fœtid, and soft layer which adheres more or less firmly to the subjacent ulcer; if it be the ulcerative, the loss of substance is greater, and the surface of the ulcer is lightly covered over by a brown or dark pulpy matter[2]. The dry form presents all the characteristics of true gangrene. It is seldom that we have an opportunity of seeing it in the earliest stage, but when we do we find a small brown eschar occupying the mucous lining of the cheek, near the alveolar edge of the gums, at their middle point. This eschar is sometimes surrounded by an inflammatory appearance, but in most of the cases which we have ourselves examined, the mucous tissue around was merely infiltrated. In a more advanced stage the walls of the cheek, gums, lips, &c. are converted into a black, soft, homogeneous mass, which exhales a strong gangrenous odour; the surrounding tissues present an hypertrophied and granular appearance, and the cellular substance is extensively infiltrated with a straw-coloured fluid, resembling serum; the periosteum of the maxillary bones is destroyed; the teeth loose or wanting, and the jaw bones themselves more or less black, or sometimes necrosed. In a few cases the mucous membrane of the pharynx and œsophagus is here and there covered with a dark fur, or in a state of gangrene. Various lesions are found in the intestinal canal, the most frequent of which is inflammatory softening of the great intestines. In the cerebral cavity we seldom find lesions of any importance; the membranes and nervous substance are commonly pale, and some fluid is effused into the ventricles or the subarachnoid space. The other pathological appearances belong more particularly to the antecedent diseases under which the child may have laboured when attacked by gangrena oris.

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[1] Dr. Marshall Hall and Dr. Willis say that the left cheek is the one almost always affected. This is an error: the gangrenous affection commences indifferently on either side of the face; in twenty cases which I have examined to determine this point, I find that it commenced in nine on the right side; in ten on the left; and in one on the lower lip.

[2] Taupin, l. c.

Treatment. — The predisposing causes of gangrene of the mouth act chiefly by debilitating the constitution and strength of the patient ; our first care, then, in the treatment of this disease must be to avoid or neutralise the influence of all predisposing agencies. The patient should be removed, if possible, to a dry, airy locality, and the greatest attention should be paid to cleanliness ; the food must be of a nourishing kind, and the constitution supported by appropriate administration of tonics. The indications of treatment are twofold ; to renovate, as we have just said, the vital powers, which are commonly depressed in this disease, and to check immediately the progress of the local affection. The surgeon should bear in mind that suspicious-looking ulcers of the mouth in weakly children, and especially in those who are convalescent from eruptive disorders, are very apt to terminate in true gangrene ; the appearances of such ulcers, at their earliest stage, have been already described ; hence it seems more prudent to commence the administration of tonic and strengthening remedies in the first stage, than to wait, as most writers advise us to do, until the more destructive form of dry gangrene has supervened. Tonic remedies require to be given for some time before they can act on the constitution, and, on the other hand, the sloughing process, when once fully established, is so rapid as to leave little time for the operation of general remedies. Infusion of cinchona bark is the tonic which is usually employed, combined, as circumstances may require, with sulphuric, hydrochloric acid, &c. During the progress of the disease laxatives must be carefully administered, in order to free the intestinal canal, not only from its vitiated secretion, but from the putrid exhalations of the mouth, which are often swallowed. More reliance, however, is to be placed on the action of local remedies. In the pseudo-membranous and ulcerative forms, when confined to the gums, &c., the diseased points should be frequently touched with some stimulant or escharotic substance. Various remedies have been recommended by different writers. At the Children's Hospital, Paris, M. Bouneau strongly recommends the chloride of lime to be applied in the following manner. The finger, slightly moistened, is dipped into a bottle containing finely-powdered chloride of lime, and rubbed pretty strongly over the diseased points of the mouth. The frictions are repeated every two, three, or four hours, the mouth being cleansed after each by a detersive gargle. M. Taupin, also, speaks very highly of the efficacy of the chloride of lime as a local remedy. The other physicians of the Children's Hospital employ the chloride in solution, or touch the parts with nitrate of silver, either solid or in a solution containing twenty grains to the ounce of water. American practitioners place much reliance on the sulphate of copper (i to ii ʒ in iv ℥ of water), which they often combine with powdered cinchona bark. Powdered alum may also be useful as a detergent ; the muriated tincture of iron, or the aromatic wine of the French Pharmacopœia are recommended by Dr. Webb of Philadelphia. At the same time that we endeavour to arrest the development of the disease by local stimulants or escharotics, we should be very careful to guard the surrounding tissues from the contact of the matter secreted by the gangrenous ulcers. Frequent ablution of the mouth must be recommended, or when the subjects are very young, injections are to be employed every two or three hours ; it will also be prudent to place a small layer of any impermeable tissue between the ulcerated gums and the surrounding healthy parts. Some practitioners even advise that the patient be placed in a prone position, to favour the escape of acrid saliva, &c., but it is almost impossible to make a child preserve this inconvenient posture for any length of time.

The above measures are suited to the early stages of gangrena oris ; but when the soft parts begin to mortify rapidly, or when the substance of the cheek is deeply involved, the most energetic treatment is required. Tonics must be liberally administered, and the diet should consist of eggs, beef-tea, or other substances of a nutritious character. The local treatment consists in the application of strong escharotics. The following are the principal remedies of this kind which have been recommended by different writers.

Actual cautery.—The actual cautery has been employed by Chopart, Dessault, and others, and strongly advocated by MM. Baron and Isnard, who regard it as much superior in its mode of action to any caustic substance. A strong objection, however, to the use of this means consists in the very great difficulty of applying it to the inside of the mouth in young children. But when gangrene has destroyed the whole thickness of the cheek, the cautery is the only application upon which any reliance can be placed. MM. Baron, Isnard, and Marjolin, relate cases of cure obtained by the employment of this powerful agent, and it has recently been used with success in this country by Mr. Henry Obré, of the Marylebone Infirmary, upon the recommendation of the writer of this article. The subject of one of Mr. Obré's cases was a child nine years of age, who was attacked by gangrene of the mouth during the period of convalescence from typhus fever. For several days the gangrenous spot on the inside of the mouth was touched with muriatic and nitric acids ; quinine was administered, and the patient's strength was supported by a nourishing diet, red wine, &c. The gangrene, however, continued to spread, perforated the cheek, and extended from the commissure of the lips to within an inch of the ear ; the actual cautery was freely applied to the external surface of the affected cheek, on the

30th March, 1840. The progress of the disease was immediately arrested, but on the 4th April it again began to spread, under the integuments, towards the eyelid, and the cautery was again applied with equal success; on the 8th the greater part of the slough produced by the hot iron was thrown off, and granulations were springing up around the edges of the wound; on the 10th the patient suffered from an attack of diarrhœa, which was soon checked, and in a week the face was completely healed. In Mr. Obré's second case the efficacy of the actual cautery in arresting gangrene was equally demonstrated, although the child did not ultimately recover. As a measure preliminary to the employment of the actual cautery, and indeed, of any other powerful escharotic, it will be advisable to remove with the knife as much of the mortified parts as possible, or to scarify the tissues freely, that the remedial agent may be enabled to act more directly on the subjacent parts. It is unnecessary to mention, that, when we have recourse to the actual cautery, great care must be taken to protect the sound parts of the mouth from contact with the instrument.

Hydrochloric acid.—This is the remedy commonly employed at the Children's Hospital, Paris, in all severe cases of gangrena oris. Van Swieten mixed twenty drops of the acid with half an ounce of honey and applied it to the affected parts, or, in dangerous cases, used the pure acid with benefit. Since then it has been extensively employed by Siebert, Boyer, Richter, Baron, Jadelot, Guersent, and other physicians. In mild cases the diluted acid may be used, but when the soft parts are deeply involved we must have recourse to the concentrated acid. It will be advisable, as has been already remarked, to remove the mortified detritus, and make a few scarifications into the tissues which are concealed by the eschars; this done, and the tongue, lips, &c. being protected from contact with the acid, it may be applied by means of a small brush, to the bottom of the wound, and to the different points involved in the disease; the cauterization must be repeated twice or thrice a day, or oftener, until the eschars are detached and the surrounding tissues seem disposed to assume an healthy action; the edges of the wound may now be touched with nitrate of silver, or stimulated by the chloride of lime, of soda, &c.: the formation of unseemly adhesions must, if possible, be prevented, and the healing process favoured by the means usually employed to hasten the cicatrization of wounds in other parts of the body.

Sulphuric and acetic acids.—These acids were, at one time, much used by German practitioners in the treatment of gangrena oris; but they have been completely superseded, in modern practice, by hydrochloric acid. Dr. Willis, however, recommends pyroligneous acid, when sloughing has commenced.

Chloride of sodium.—This remedy appears to have been introduced by Rey[1], who derived great benefit from it in one case; it is also recommended by Dr. R. Willis, but the superior efficacy of the chloride of lime is supported by a much more extensive experience at the Children's Hospital.

Sulphate of copper.—This substance has been long used by American practitioners in the treatment of gangrena oris. They employ it in all stages of the disease, in the proportion of one to two drachms of the sulphate (with $\frac{1}{2}$ oz. of powdered cinchona bark), to four ounces of water. This formula was first proposed by Dr. Coates, but the cinchona might probably be omitted without any inconvenience.

The treatment recommended by British writers does not differ, in any essential particulars, from that which has been described above. Underwood's very imperfect description of "gangrenous erosion of the cheeks" is taken from Mr. Dease, who gave bark internally, and applied muriatic acid, mixed with honey of roses, to the affected parts. Mr. Wallace administered carbonate of ammonia internally, in doses of five, ten, and twenty grains, and touched the gangrenous eschars with pure nitric acid. The local remedies employed by Burns are chloride of lime, and nitrate of silver, with carrot or yeast poultices. Dr. Robert Willis also recommends the nitrate of silver, or sulphate of copper, in the early stage; and when sloughing commences, pyroligneous acid, or chloride of soda, with generous diet, tonics, &c.

Towards the close of the disease diarrhœa very frequently supervenes, and is always troublesome. It may depend either on the passage into the intestinal canal of the putrid secretions of the mouth, or on some sub-inflammatory affection of the intestinal mucous membrane. The distinction between these two causes is not easily drawn; it will, however, be prudent to give some mild aperient for the purpose of carrying away any irritating matter which may be contained in the intestines, and then administering an astringent. The pneumonia which frequently complicates severe cases of gangrena oris is commonly latent, and too often beyond the resources of our art. Even local blood-letting is inadmissable, but counter-irritants may be applied to the chest, and the white oxyde of antimony, or tartar emetic, in full doses, given internally.

BIBLIOGRAPHY.—The following standard treatises on Gangrena Oris may be consulted with advantage:—*Cumin*, Dublin Hospital Reports, vol. iv. p. 330. *Baron*, Journal de Méd. t. 36. Paris, 1816. *Isnard*, Thésis, No. 188, Paris, 1818, and in Journal Compl. t. 4, 1819. *Coates*, North American Med. and Surg. Journal, 1826. *Richter*, Der Wasserkrebs der Kinder. Berlin, 1828. *Taupin*, Journal des Com. Méd. Chirurg. No. 10, 1839, p. 134. *Naumann*, Handb. der Med. Klin. article Cancrum Oris. *Encyclopæd. Wörterbuch* der Med. Wissen; same article. In addition to the above more or less information may be obtained from the following, which are of less importance. *Wiegand*, Monograph. des Wasserkrebs. Erlang. 1820. *Hesse*, Ueber die Erweich. der Gewebe, &c. Leip. 1827. *Mende*, in Hufeland's Journal, st. 10, s. 24. (1806 and 1809). *Michaelis*, same Journal, st. 1,

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[1] Revue Médicale, t. vi. p. 184.

s. 107. (1809). *Neuhof*, same Journal, st. 2, s. 86. (1810). *Siebert*, same Journal, st. 12, s. 74. (1818.) *Busch*, in Siebold's Journal, bd. 8. s. 496. *Romberg* in Rust's Magazin, bd. 30. H. 1. s. 144. *Hueter*, in Gräfe und Walther's Journal, bd. 13. H. 1. s. 26. *Rey*, Revue Médicale, t. vi. p. 184, *Marshall Hall*, Edin. Med. and Surg. Journal, vol. xv. p. 547. *Green*, Lancet, vol. ii. 1839-40. *Webb*, Medical Examiner, No. 35, 1839, Philadelphia. *Willis*, Illustrations of Cutaneous Disease. London, 1840.

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CANTHARIDES, a species of insect employed in blistering. (See that article.) The tincture of cantharides is also employed in incontinence of urine, sluggishness of the bladder, gleets, &c. In powder, it is sometimes added to stimulating ointments, to insure their effect. A blistering tissue, containing the vesicating principle of the Meloe vesicatoria, has been of late introduced, and may be considered as a *Benzoate of Cantharidine*. It is free from most of the inconveniences of the common blistering plaster. This preparation, which is spread on paper, is not injured by keeping—may be carried in the surgeon's pocket-case, and cut into segments of any shape or size for instant use.

CANULA, dimin, of Canna, "a reed;" *tubulus*, Lat.; *Röhrchen*, Ger. A long, hollow, usually cylindrical instrument, open at both ends, employed to protect the neighbouring organs, and at the same time to convey medicinal substances, instruments, ligatures, &c. into deep seated parts. Canulas are made of wood, metal, or elastic gum.

CAOUTCHOUC, or CAUCHUC, from its Indian name Cahuchu; *Federharz*, Ger. The indian rubber, as it is commonly called, is obtained in the form of a milky juice from the Hevea guianensis, and various other trees in South America and Java. The juice flowing from incisions made into the bark of the tree, is received on clay moulds, and dried in the sun, or by artificial heat; the watery portion being thus evaporated, the caoutchouc remains in the state in which it is imported. But even the juice itself has of late years been brought to this country. In the state of cohesion, it is insoluble in alcohol. When treated with hot naphtha, it swells to thirty times its bulk, and if then triturated with a pestle and passed through a sieve, it forms a homogeneous varnish, which being evenly spread on cloth, by means of a flat edge, constitutes the process of preparing the water-proof cloth of Macintosh. Two surfaces of the cloth thus varnished are then brought into contact, and united evenly by being passed through rollers.

This substance has been also made available in the manufacture of webs, ribands, braces, and even of cloth. Notwithstanding the varied and useful properties which recommend it in a peculiar manner for surgical purposes, it has not yet received anything like the attention it deserves on the part of the profession. Many years ago, and long before its manufacture had reached its present advanced state, it was proposed by the late Dr. Addie, of Stockton, to employ caoutchouc in a great variety of ways, tending to promote health, cleanliness, and comfort. With a bed formed of this material, and which would be perfectly portable, the soldier would find ready quarters. Mariners and coast-guards would find in it light and durable materials for life-boats, &c. Field-labourers, and all persons who toil in the open fields, in our latitudes, would find in it a cheap, clean, and protective clothing. In hospitals, caoutchouc beds would conduce greatly to the comfort of the sick, as they do not become impregnated with morbid secretions, or other impurities that necessarily occur during the course of diseases, a spunge and warm water being all that is required to free them from any accidental soil. By a judicious arrangement of buckles and straps, and regulating the insufflation of the bed, the patient may instantly be placed in any posture that may be desirable, without even touching him. In lying-in hospitals, where it is so difficult to keep the mother comfortable on account of the lochial discharge, they would be of very great importance.

In ships, these beds might be used as hammocks, and if threatened with shipwreck, they would afford a resource to the crew by which many might escape. In military campaigns, it might and ought to be employed in many more ways than it now is: as stretchers for carrying the wounded from the field, and on which they might remain till the surgeon could attend to them, a caoutchouc bed would be infinitely preferable for this service, to the clumsy modes now in use. The following are the chief uses made of this substance in surgery, though with a little ingenuity on the part of surgeons, many more applications of it might be usefully made. It is made into bag-syringes and clysoirs, for various kinds of injection, acoustic and œsophageal tubes, canulas, catheters, bougies, urinals for persons labouring under incontinence of urine, nipples for sore breasts, pessaries, trusses, air-pads, cushions, and water-bags for relieving pressure, or imparting warmth or cold, elastic webs for bandages, laced stockings for varicose veins, knee-caps, gout-socks, hospital sheets, tape for setons, &c. Dr. Arnott applied with great success the Macintosh cloth to the manufacture of his hydrostatic-bed, and Mr. Cow, of her Majesty's dock-yard at Woolwich, has introduced into the government hospitals, inflated pads and cushions, of the required forms to be used, instead of bandages in cases of fractured limbs, gun-shot wounds, &c.

CAPELINE, a bandage for the head. By extension, French writers have used the term in speaking of a bandage for fractures of the clavicle or scapula, and even for the stump of the arm. See Bandage.

CAPISTRUM, *chevestre*, Fr., a name given to various bandages of the head. See

Bandage, Fig. 149, where the name applies to a bandage for fracture of the lower jaw.

CARBUNCLE, from *carbo*, a burning coal. See Anthrax.

CARCINOMA. See Cancer.

CARIES. See Osteitis.

CARTILAGE. See Chondritis.

CASTRATION, *Verschneidung*, Ger. In surgical language this term is applied to the ablation of one or both testicles by a surgical operation. It is now never resorted to, except in cases where the alteration or disorganization of the seminal gland is considered to be incurable, and the general health of the patient cannot be preserved by other means; and in this class may be ranged its tuberculous and cancerous affections. In the latter, however, it may be inadmissible, as when, for instance, the disease of the testicle has reached it by extension, from parts deeply seated, and out of reach. Indeed, however boldly the extirpation may be conducted, in the case of fungoid disease of this organ extending along the cord,—and some surgeons, like Ledran, have carried it up the spermatic cord as far as the iliac fossa,—candour obliges me to say, that I have never seen it successful in arresting the ulterior progress of this intractable disease. The operation, however, may be undertaken, provided the cord and the inguinal glands be still free from any trace of the affection. Where the degenerescence has not proceeded beyond the schirrous state, even though the hardness should extend to the cord, the gland and thickened cord may be removed. I have also known castration to be performed for chronic suppuration with numerous sinuses through the scrotum, and even for the disease known as irritable testis.

Although several methods have been proposed by surgeons, and some variety may doubtless be necessary in its performance, depending on the nature of the case for which it is employed, still a general description, embracing the important points of the operation, will suffice for the guidance of the surgeon.

The pubes being clearly shaved, for if the hair be left on either side, it will be productive of inconvenience, either at the time of the operation, or subsequently, when the adhesive straps are applied in dressing; a table of convenient height is prepared by covering it with two blankets and a sheet, and a T bandage is fastened round the patient's loins. A straight and convex-edged bistoury, scissors, forceps, and tenaculum, with ligatures, sponges, and warm water being at hand, the operation, which consists of three steps, namely, the division of the integument, the section of the cord, and the dissection of the tumour, may be proceeded with. The patient being placed on his back, the surgeon makes an incision down the front of the tumour, from the abdominal ring to the lowest part of the scrotum. A double advantage is thus attained, as the diseased gland is much more easily removed, and when suppuration has set in, the matter does not stagnate in the scrotum. If the tumour be large, or the skin diseased, it will be best in either case to remove a portion of the skin with the tumour. This is done by forming the incision with two branches, including an ellipsis of such dimensions as will remove the whole of the diseased integument; in this manner the necessity of having recourse to a tedious and painful dissection, when the skin is adherent to the tumor, is avoided, and the formation of a large bag, even of sound skin, which would otherwise remain after the excision of a very large tumour is prevented.

Sometimes a small exploratory incision is made into the tunica vaginalis on the forepart of the testis, with a view to satisfy the surgeon's mind that the disease is neither a hydrocele nor a hæmatocele, and I approve of the practice when there is a doubt on this point. Pott mentions his being once so deceived by appearances, that he removed a testis which was all but healthy, and which, had he resorted to a preliminary incision, he would have preserved; simple hydrocele, where the tension is great, and there is neither transparency nor fluctuation, may be, and has been, mistaken for indolent scirrhus. The liability to this error will be still greater when the tunica vaginalis presents a degree of hardness equal to that of cartilage; and this change in its structure, in connexion with hydrocele, is not unfrequent. In making this exploration, the bistoury is the proper instrument; a trocar should not be employed, as it might not answer the end in view, and the testicle would be unnecessarily exposed to injury.

If the external pudic artery, or any of its branches, should furnish blood in a stream, they should be secured. The remaining envelopes of the gland and cord are then to be carefully divided, beginning above near the abdominal ring, where the cord is still concealed by a prolongation of the fascia transversalis and the cremaster muscle, and to which they form as it were a sheath. The best way to do this is to raise these tissues layer by layer, and divide them on a canula or director, until the cord is laid bare. The neglect of this precaution by practitioners who cut the spermatic cord before they have freed it of its muscular envelope is the chief, if not the sole cause of the retraction by which they may be subsequently embarrassed. I have seen the surgeon, in a case where the divided cord had retracted within the abdominal ring, obliged to cut the external oblique, in order to get at the bleeding vessels. In another case which came under my observation, the bleeding from the vessels of the retracted cord was so profuse, that the operator was convinced he had wounded the iliac artery, and unfortunately proceeded to place a ligature on that vessel. The patient died the day after the separation of the ligature. I examined the body myself. The iliac artery, though not wounded, had been tied securely enough, but the vessels of the cord, the source of the hæmorrhage, had been neglected. When the cord is fully exposed, a tenaculum or a needle and ligature may be passed through it; it may be then divided. By lifting up the cord on the tenaculum, the spermatic artery will be seen bleeding; it should be drawn forwards and secured with a fine ligature. If the cord be then turned upwards towards the abdomen, the artery of the vas deferens may be secured in the same way. The latter vessel is sometimes not tied at all, and this is a neglect which the surgeon will now and then have reason to regret, as it furnishes a most teazing and continued bleeding. Hæmorrhage is, in fact, more frequent from the deferential, than from the spermatic artery.

I recommend the cord to be divided before the diseased tumour is removed, as I think there can be no doubt as to the impropriety of dissecting around the testis before this step is completed, as it obviously prolongs the time of the operation, and adds considerably to the sufferings of the patient. On the other hand, when the cord is first divided, the testis is easily drawn forth from the scrotum, by means of the cord itself, and the adhesions that may exist are cut or broken down with greater facility and rapidity, than by any other mode.

If the tumour be a small one, it may be rolled out, and as it were unkernelled from its scrotal envelopes; but on the other hand, if it be of considerable size, it will be necessary to adopt some precautions to avoid wounding the urethra, the corpora cavernosa, and the testis of the opposite side. The bleeding too may be very troublesome in consequence of enlargement of the scrotal vessels. J. L. Petit mentions an instance in which the dressings had to be removed no less than three times to arrest a hæmorrhage, which was at last discovered to proceed from the artery which passes through the septum of the scrotum. Indeed there is much more risk of bleeding after castration from the vessels of the scrotum than from those of the cord.

Bichat before dividing the spermatic cord, directs the vas deferens, which may be distinguished from the blood-vessel by its hardness, to be laid hold of, the rest of the cord is then cut, and the arteries secured, before the vas deferens is cut. Roux has attained the same object by making small successive cuts, tying each vessel as soon as it furnished blood until the section was completed. Some of the French writers have of late supposed that the danger of exciting inflammation along the cord, and of tetanus from the application of a ligature on the cord *en masse* was more imaginary than real. I am by no means of this opinion; on the contrary, I cannot too strongly reprehend the barbarous practice of surgeons of former times of tying the whole of the cord to secure its vessels, a practice which is not only horribly painful, but sometimes dangerous. Mr. Chandler, in compliance with the custom, removed in 1807, the testis of a man in St. Thomas's Hospital, and tied the whole cord in a single ligature, the man at the time complaining dreadfully. The ligature came away in eight days, tetanus set in on the following day, and terminated fatally in forty-eight hours.

The vessels of the scrotum are next to be secured, and when all the bleeding is arrested, the skin should be brought together by two points of suture at least, so as to prevent its edges from turning inwards. The confrontation of the edges of the wound would not here be sufficient to prevent this occurrence, on account of the great extensibility and retractility of the tissues themselves. The patient is then to be carried to bed in a horizontal posture, without any dressings being made to the wound; and when all apprehension of bleeding has ceased, then and not till then, should lint and adhesive plaster be applied, and the T bandage be secured. The ligatures of the cord are to be brought out together at the upper angle of the wound, where they may be protected by a small piece of linen. He must be kept cool, being covered only by a sheet to prevent relaxation of the scrotum; and in summer, cold water and spirits of wine should be applied. The sutures should be removed on the eighth day, the wound heals generally in three weeks. After the patient is removed to bed he must be carefully watched, and any symptoms of inflammation, as indicated by severe pains in the loins, or over the abdomen, should be at once combated by copious bleeding.

Disease of the testicle requiring extirpation, may be complicated with hernia. I once removed a diseased testis under such circumstances. I first returned the hernia, and then dissected the cord from behind the sac. In another case, where there was an omental hernia adhering, I secured the arteries of the cord separately in small ligatures, and the patient had no bad symptoms. Sir C. Bell mentions an instance, where the diseased gland acted as a truss, preventing the descent of the intestine. After the removal of the tumour, the patient had a fit of coughing, followed by the protrusion of the bowels.

For Bibliography, see Testicle, Diseases of.

(*Astley Cooper.*)

CATAPLASM. See Poultice.

CATARACT. *Cataracta* has been derived from the Greek καταράσσω, to disturb, destroy, or abolish. It seems to have been first used by the Arabians. The earlier Latins called this disease *suffusio oculi, gutta obscura, gutta opaca, hypochyma, Cataracta; Cataracte*, Fr.; *Grauer Staar*, Ger.; *Cataract*, Eng.

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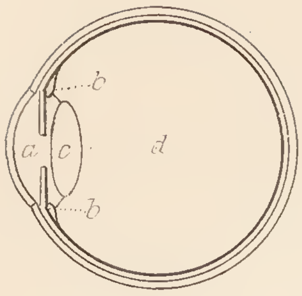

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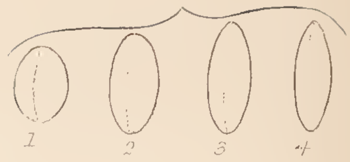

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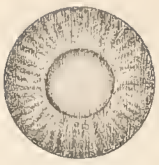

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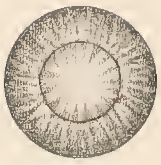

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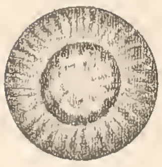

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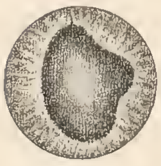

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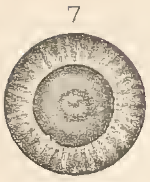

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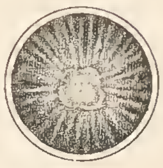

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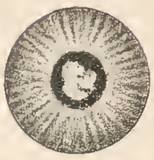

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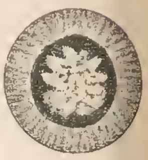

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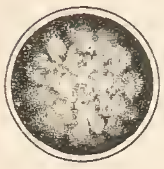

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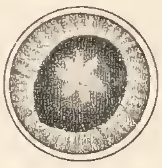

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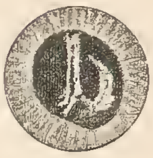

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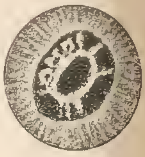

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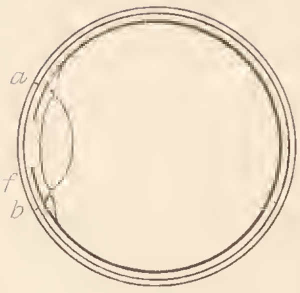

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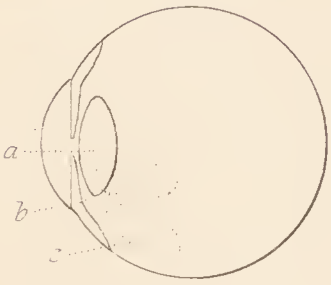

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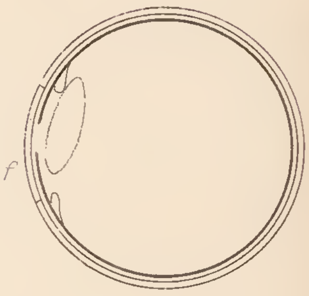

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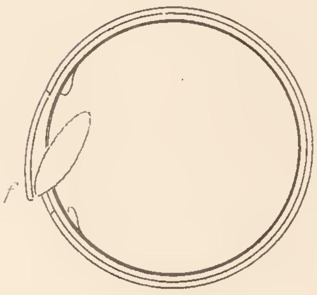

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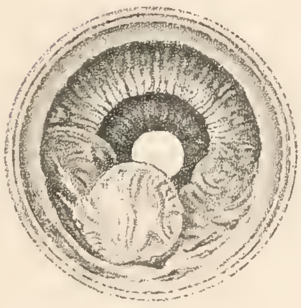

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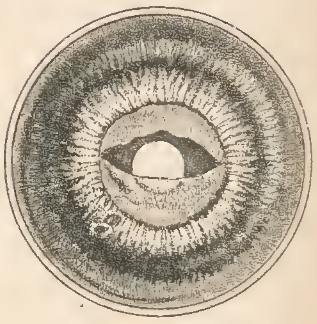

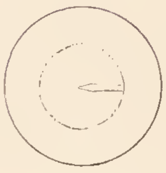

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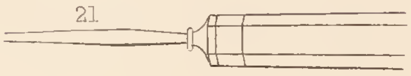

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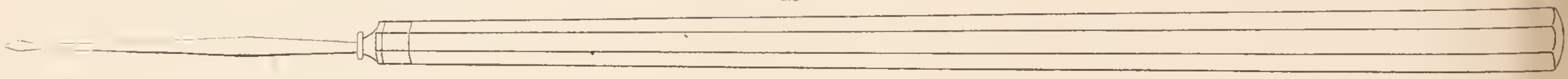

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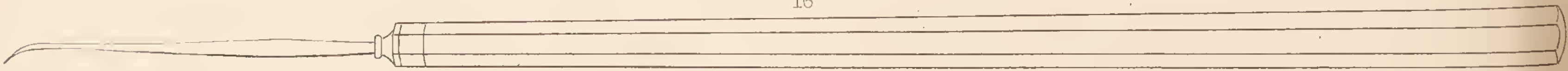

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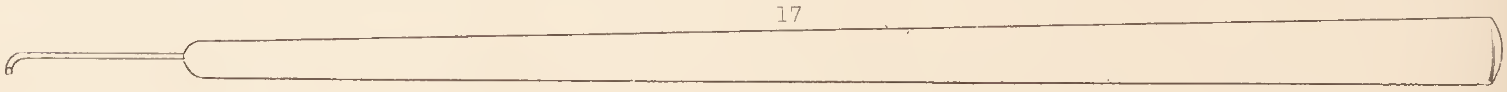

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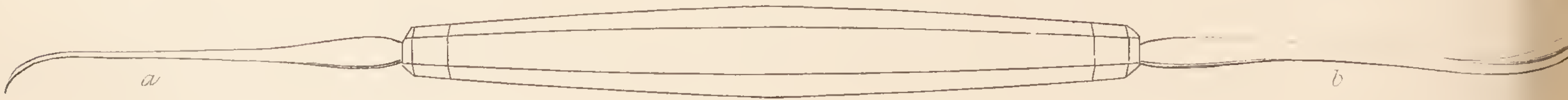

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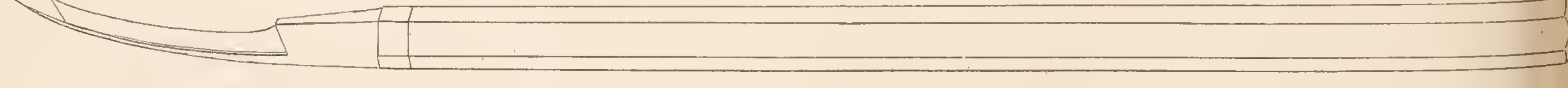

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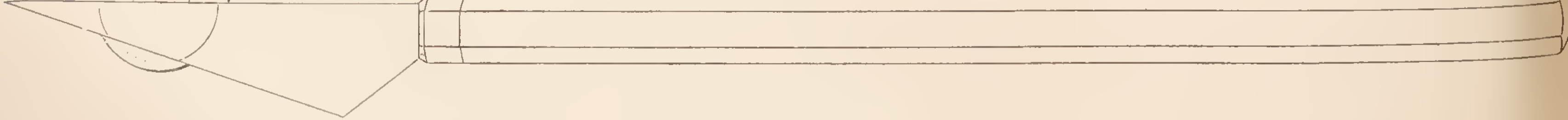

Alfred Adlar

The term cataract is used to denote that disease of the eye, in which an opaque body, situated between the iris and vitreous humour, disturbs and destroys vision. This disease usually consists of an opaque state either of the crystalline lens, of its capsule, or both; but it may also consist of opacity of the liquor Morgagni, or of opaque lymph effused into the pupil, in front of the capsule of the lens.

The true nature and seat of cataract does not appear to have been distinctly understood till the beginning of the eighteenth century, when Antoine Maitre Jean made it known to the world, by a publication on the subject in 1707. This learned author was followed by Brisseau, Heister, St. Yves, Petit, and Daviel. Many highly distinguished authors have since advanced our knowledge of this subject both in Britain and upon the continent of Europe. Among these may be enumerated Walther, Langenbeck, Buchhorn, Reisinger, Beer, Richter, and Weller, in Germany; Sabatier, Delpech, Demours, Boyer, and Wenzel, in France; Scarpa, in Italy; and Ware, Pott, Hey, B. Bell, Gibson, Saunders, Wardrop, Travers, Guthrie, Lawrence, Mackenzie, Tyrrell, Middlemore, &c. in Britain. As might be expected from such a combination of talent and learning, brought to bear on this subject, and their extensive opportunities of experience, our knowledge of the nature and treatment of cataract has attained a very high degree of perfection.

Before entering upon the nature, symptoms, and treatment of cataract, we shall premise a very brief sketch of the anatomy and physiology of the chrystalline lens; for, by so doing, the account we are to give of cataract and its treatment will be much better understood; the proper treatment of this disease being founded more upon the anatomy and physiology of the lens, and the natural changes it undergoes under particular circumstances, than upon the nature of the disease.

§ I. Anatomy and Physiology of the Crystalline Lens and its Capsule.

Of the three humours which occupy the interior of the eyeball, the crystalline humour or lens stands interposed between the aqueous humour, which is in front, and the vitreous humour, which is behind. The lens is a double convex and transparent body, of a circular form. It is situated almost immediately behind the iris; its central part, which is behind the pupil, may, therefore, be distinctly seen, as it has there only the transparent cornea and aqueous humour interposed between it and the observer. Fig. 1.

When the crystalline lens retains its natural transparency, the pupil in the living body has the appearance of a black spot, and the presence of the lens cannot be discerned; but when the lens is affected with cataract, it is distinctly seen behind the pupil, in consequence of its opacity arresting and reflecting the rays of light which enter the eyeball.

The lens is contained in a capsule or proper investing tunic. This capsule is thin, transparent, and somewhat elastic. The anterior part of this capsule, which covers the anterior convexity of the lens, has the aqueous humour in contact with it;—the posterior part of the capsule of the lens, which covers its posterior convexity, is in contact and intimately connected with, the capsule or investing tunic of the vitreous humour. Hence the anterior half of the crystalline lens, covered by its capsule, projects into the aqueous humour, while the posterior half projects backwards, into the vitreous humour.

Each of these parts of the capsule of the lens may be considered to consist of two layers; the one, which is in contact with the lens, forming its proper capsule, while the more exterior layer consists of a part of the capsule or membrane of the aqueous humour anteriorly, and of the hyaloid membrane of the vitreous humour posteriorly.

The crystalline lens is solid, soft, and of a firm gelatinous consistence at middle age; but is softer in youth, and becomes firmer and harder as age advances. During infancy and childhood, the lens is nearly globular, and, as age advances, it becomes less so, and growing gradually flatter towards manhood, till it assumes the form of a double convex lens, composed of segments of two spheres, possessing different degrees of curvature, the anterior one being less curved, or forming the segment of a larger sphere than the posterior one. In youth, therefore, the lens is of greater convexity and stronger powers than in after life. Fig. 2.

In youth the lens is quite transparent and colourless, but in old age it acquires a yellowish amber colour. This shows itself in the living eye, by slight opacity of the lens, which does not materially affect the sight. By boiling, the lens becomes coagulated, and is found to consist chiefly of albumen. When so boiled in water, it may be separated into concentric layers.

The lens and its capsule do not appear to have any adhesion to each other. There is a small quantity of fluid interposed between them, which has been called the *liquor Morgagni*. It is also highly probable that the lens is connected to its capsule by very minute colourless bloodvessels, which pass into it from its capsule at the margin.

The circumference or margin of the lens is not in contact, as has been supposed, with the anterior extremities of the ciliary processes. A portion of the other humours of the eye occupies a small space around the lens, between it and these processes. This space may be called the *zonula lucida;* for in cases where the lens is opaque, the light is admitted into the eye through this ring. The vitreous humour, enclosed in its hyaloid membrane, projects anteriorly as far as the ciliary processes around the margin of the lens, so as to form the posterior part of this transparent ring or *zonula lucida.* Upon the membrane covering this portion of the vitreous humour anteriorly, very minute vessels radiate from the ciliary processes to the anterior wall of the capsule of the lens. The posterior wall of the capsule is supplied with blood by the capsular branch of the central artery of the retina.

The crystalline lens forms an important part of the visual organ. Its functions are those of a double convex lens, for refracting and concentrating the rays of light, which enter the eye upon the principle of an acromatic lens. From the situation of the lens, almost the whole of the light which enters the eye must pass through it, as well as through the other humours. Hence, when the crystalline lens becomes opaque, it forms an obstruction to the light, which prevents the rays from reaching the retina. Opacity of the lens, therefore, does not impair the sensibility or functions of the other parts; it only acts like a curtain, interposed between the luminous body and the sentient part of the eye. As the rays of light are not refracted in the eye by the crystalline lens alone, this body may be removed from the axis of vision, and its refractive power compensated by the use of glasses or artificial lenses.

When the anterior part of the capsule of the lens is ruptured, and the lens wounded, by which the aqueous humour gets admission so as to act upon its texture, the lens becomes opaque, and is dissolved by that fluid. This is a process by which the wounded and opaque lens becomes removed from the eye, in consequence of the continued or successive absorption of the aqueous humour which holds it in solution. Upon this very remarkable process, as well as on the anatomy of the lens, some important and beautiful operations are founded for the removal of cataracts, as will be afterwards more fully explained.

§ II. Of Cataract.

1. *Symptoms of.*—The symptoms which attend the existence of cataract vary in different cases according to the nature of the cataract, and other circumstances by which it may be accompanied.

The first, the most important, and, in many cases, the only symptom which attends the existence of cataract, is impaired vision. This indistinctness of sight varies in degree, from being only like a mist before the eye to that of complete blindness; being modified by the extent, degree, and nature of the opacity, which constitutes the cataract.

The partial or complete loss of distinct vision, which is occasioned by cataract, is of a peculiar kind. It takes place from the very commencement of the disease, and gradually increases as the opacity becomes greater, till the patient becomes blind. The sight of the eye, however, is not altogether lost. Though the patient has no useful vision, he can yet distinguish light from darkness, in consequence of light being only intercepted in its direct passage to the retina, by the opaque body. But some light is generally admitted to the retina, either in consequence of the cataract not being completely opaque, or indirectly at the circumference of the lens through the transparent space between it and the ciliary processes. This transparent space, surrounding the lens, which has been above denominated the *zonula lucida*, manifests itself by appearing like a black ring around the opaque body, when the pupil is fully dilated. There are some cases, however, in which light is not admitted to the retina, owing to the complete opacity and increased size of the lens, or its adhesion to the iris. When the lens is neither completely opaque, increased in size, nor adhering to the iris, and yet the patient cannot distinguish light, the cataract is generally complicated with some other disease of the eye, as shall be afterwards pointed out.

As light is admitted into the eye in cases of cataract, in the manner above-mentioned, these patients frequently complain of the distressing glare of light which is constantly before them. The rays of light being admitted at the circumference of the lens, are refracted in all directions, cross each other within the eye, and so cause this troublesome sensation.

In cataractous eyes, the quantity of light admitted depends also on the size of the pupil. On account of the pupil dilating in a dull obscure light, patients then see more light, or distinguish objects better than they can do otherwise. When the pupil is dilated by belladonna, the patient, who was previously blind, sometimes sees so much better while the effects of this substance continue, as to be able to distinguish objects, and even to read. The dilatation of the pupil, by this medicine, is of great use in examining cases of cataract. It enables the examiner to see the disease more thoroughly, the state of the iris, and elucidates doubtful cases.

When indistinctness of vision arises from cataract alone, it depends so much on the degree of the opacity, that the surgeon can in general pretty accurately estimate from the appearance of the eye how much it is impaired. It is of great consequence to observe that a slight degree of opacity in the lens is frequently observed to exist in elderly persons from the lens becoming of an amber colour without vision being much, if at all, impaired. When a patient who complains of blindness, therefore, has only this degree of opacity in the lens, his loss of sight must depend on some other cause.

A cataractous lens appears to be much more opaque when in the eye than it does when removed from it. Though it may seem perfectly opaque in the eye, it appears to be semi-transparent when extracted. So that the opacity of a cataract may appear to be very considerable, and yet may not materially impair vision. When a semi-opaque lens has a mottled or striated appearance, vision is much worse than when the opacity is uniform.

Along with impaired vision, in many cases of cataract, there are other symptoms connected with the disease. These are symptoms of chronic inflammation, indicated by tenderness of the eye to light,—a sense of heat in the eyes,—and increased vascularity. These symptoms vary in degree at different times, but take place frequently, particularly upon any cause of excitement. By many this has been considered as the cause of spontaneous cataracts. M. Petit observed that in 300 cases of cataract, two-thirds of them occurred in persons who had exerted their eyes much in a strong light.

2. *Different kinds of Cataract.*—The most distinguished authors who have written on the subject of cataract have divided and arranged the various forms of the disease differently. The disease termed cataract consists, as has been already mentioned, of an opaque state of the whole, or a part, either of the crystalline lens, its capsule, or of both these parts,—an opacity of the *liquor Morgagni*, or an opacity consisting of lymph deposited on the capsule of the lens, or in the posterior chamber of the aqueous humour filling up the pupillary aperture. Hence all the different kinds of cataract may be included under the following:—1. *Lenticular Cataract*, in which the opacity is situated in the lens itself. 2. *Capsular* or *Membranous Cataract*, in which the capsule is the seat of the opacity. 3. *Capsulo-Lenticular Cataract*, where both lens and capsule are opaque. 4. *Cataract of the humour Morgagni;* and, 5. *Adventitious Cataract*, in which the opacity consists in an opaque effusion between the capsule of the lens and pupillary aperture.

Assuming these as generic terms, or as denoting different genera of the disease, all the different species of cataracts may be included under them.

(*a*) *Lenticular Cataract.*—Opacity of the lens, constituting lenticular cataract, is the most common form of the disease. Lenticular cataracts may vary in colour, consistence, and size, in different cases. In colour, they are generally white, yellowish, or bluish-white; greenish, whitish, or bluish-grey; striated, radiated, or speckled, and sometimes, though rarely, brown, which last have been termed black cataracts. In consistence they vary from fluid, to a firm cartilaginous consistence, or even bony hardness. When the cataract is of a yellowish or amber colour, or is dark grey, the lens is generally hard, also when radiated, or more opaque at the centre than the circumference, it is generally hard. When light or blueish grey, soft. When completely white and uniformly opaque, generally fluid, within an opaque capsule. When an opaque lens appears to be larger than the size of the natural lens, it is generally soft or fluid. The opacity commences, or is first apparent, in the centre of the lens, and extends towards its circumference. In old persons, the opacity is generally of a darker colour than in young subjects, being, in the former, generally of a yellowish grey colour, while in the latter, it resembles half-boiled white of egg, or milk and water.

The consistence of lenticular cataracts is most commonly that which the lens should possess in its natural state at the age of the patient in whom it occurs. Thus they are generally found to be soft in childhood, gelatinous in youth, firm at middle life, and hard in old age.

The size of lenticular cataracts is generally that of the natural lens. But when soft or fluid, it is generally larger, and when hard, smaller.

The opacity affecting the lens may be partial, or it may be general; when partial, it is usually confined to the centre of the lens, which in some cases I have found converted into bone; but in other more rare cases, the disease consists of one or more opaque spots in other parts of the lens. When the whole of the lens is affected with opacity, the centre of the lens always appears to be more opaque than it is towards its circumference, arising probably from its greater thickness at the centre. Lenticular cataract most commonly takes place spontaneously in elderly persons. It takes place gradually, and hence the impaired vision at the commencement consists only of a slight mist or cloudiness before the eye. This gradually increases, till the patient fails to discern minute objects; but he generally retains so much sight as to be able not only to distinguish light and shadow, but even bright colours; the vision is better in twilight, and worse during the day, on account of the expanded state of the pupil in the former case, and its contracted state in the latter.

In this kind of cataract the motions of the iris are natural and lively, and the opaque lens appears to be situated at a sufficient distance behind the pupil, particularly when it is dilated, to receive a shadow from the iris, which forms a blackish line, within the circumference of the pupil.

(*b*) *Capsular Cataract.*—Opacity or cataract may affect the capsule of the lens only. It may be situated in the anterior part of the capsule, in the posterior part, or both. The opacity may be general, or may be only partial, being confined to one part, or having the appearance of several opaque lines, or spots.

When cataract is situated in the anterior part of the capsule, it is easily recognised, but when situated in its posterior part, it is in some cases with difficulty distinguished from any opacity of the vitreous humour, of the lens itself, or of the retina.

In many cases of capsular cataract the lens is wanting, either by having been spontaneously absorbed after an injury, or removed by an operation. If the capsule of the lens has been ruptured, the lens generally becomes dissolved and absorbed by the aqueous humour: a contracted opaque capsule then remains.

When the capsule becomes opaque after the removal of the lens by an operation, it is called *secondary cataract.* This generally takes place by the capsule having been detached from its vascular connexions. In consequence of this it becomes dead, opaque, shrivelled, and contracted. But it may also become opaque without having been detached or having lost its vitality.

The capsule of the lens is incapable of being dissolved by the aqueous humour.

The anterior part of the capsule of the lens is much more frequently affected with opacity than the posterior part.

Capsular cataracts are in general of an uniform pearl or chalk white colour, and appear to be situated nearer to the iris than when opacity is confined to the lens. The opacity may affect the anterior part of the capsule partially or wholly. When partially, it has often a speckled or striated appearance.

Cataract of the posterior capsule of the lens is comparatively of rare occurrence. "The opacity is never uniformly diffused, but always exhibits the form of radiating lines proceeding from the centre of the affected membrane. The ground upon which these opaque lines are placed, is evidently concave, while the lines themselves, being seen through the crystalline, have a watery dulness of appearance, which forms a striking contrast with the sharp, chalky whiteness of the specks, in anterior capsular cataract. Occasionally both hemispheres of the capsule are the seat of partial opacity, the lens remaining transparent[1]." Secondary cataract of the posterior part of the capsule has sometimes the appearance of a few opaque shreds upon the anterior part of the vitreous humour. In some cases these shreds appear to radiate from a centre.

Cataract of the posterior part of the capsule, when seen through the lens, appears to be deep seated, leaving a concave surface, and does not appear to possess the same degree of opacity which we so frequently observe in other kinds of cataract. "This change in the capsule is followed by opacity in the lens; it may exist, however, a considerable time before the lens begins to lose its transparency. Although the affection is comparatively rare, I have seen many cases of posterior capsular cataract; the patients are still able to read large, or even ordinary print long after the existence of the disease has been clearly ascertained. They can see much better when the eye is shaded, or when the pupil is artificially dilated. In the latter state we see distinctly the transparent spaces between the opaque radii, through which the light passes to the retina. When opacity of the lens commences, which may not be for two, three, or more years, vision is more seriously impaired[2]."

In many cases of cataract, apparently affecting the posterior part of the capsule of the lens, the opacity is found to exist in the lens itself when an operation is performed.

(*c*) *Morgagnian Cataract.*—Opacity of the Morgagnian fluid, between the capsule and the lens, forms a rare species of cataract. "The effusion of an opaque fluid between the lens and its capsule, forms one of the rarest kinds of cataract. It is generally followed, after a time, by disorganization and dissolution of the lens, and, not unfrequently, by capsular opacity.

"So long as this cataract consists in a mere effusion between the capsule and lens, it presents a cloudy appearance, as if formed of milk and water imperfectly mixed. It is stated that if the eyeball is repeatedly rubbed with the finger through the medium of the eyelid, the clouds of opacity change their outline and position; and sometimes they do so merely on quick motion of the eye from side to side.

"The capsule is distended in cases of Morgagnian cataract, and pressing against the iris, obliterates the posterior chamber, and impedes the motions of the pupil.

"When the disease is purely *Morgagnian*, vision is sometimes but slightly impaired, small objects escaping the observation of the patient, especially after the eye has been rubbed or moved; but after the lens dissolves, the sight is limited to the perception of light and shade[1]."

(*d*) *Capsulo-Lenticular Cataract.*—Opacity of the lens and its capsule are very frequently conjoined in the same case. "Partial capsular opacity is not unfrequently combined with firm lenticular cataract, the two strata being readily distinguished, not only by their colour, but by their position. More commonly the lens is soft in capsulo-lenticular cataracts, and the capsule itself, having been the seat of the disease, is more or less thickened and indurated. Hence the cataract is generally large, often pushing forwards the iris, and making it bulge against the cornea, so as to destroy for the time the anterior chamber[2]."

When an opaque lens is either fluid or softer than natural, the capsule is generally opaque also. A semi-opaque lens having some parts quite white, like spots or specks upon it, is a common form of this kind of cataract; those parts where both capsule and lens are affected, having a more opaque appearance than the rest.

This kind of cataract presents several different and distinct species. These are so dissimilar, that authors have been enabled to describe them as distinct varieties. These are: 1st. Central capsulo-lenticular cataract, when the opacity is confined to a single central opaque spot. This is not unfrequent in children whose eyes have suffered from internal inflammation. By some this form of cataract has been considered congenital. 2d. Common capsulo-lenticular cataract, or that form of it most frequently met with. It takes place from injuries of the lens as well as spontaneously. The opacity is partly of a chalk or pearl-white colour, as in the anterior capsular cataract, and partly cloudy, as in the lenticular and *Morgagnian* cataract. The opaque specks upon the capsule present numerous different forms in different cases, and hence by the older authors they were distinguished under the names of *cataracta marmoracea, fenestrata, stellata, punctata, dimidiata*, &c.; distinctions which are not now in general use.

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[1] Mackenzie on the Eye, ed. 3. p. 650.

[2] Lawrence on the Eye, p. 404.

[1] Mackenzie, p. 650.

[2] Lawrence, p. 405.

When opacity of both lens and capsule is only partial, the patient's vision is considerably improved when the pupil becomes dilated, either by a diminution of light, or by the application of belladonna.

The consistence of the lens in capsulo-lenticular cataract is very various, being in some cases hard, in others, soft or fluid, like milk. When fluid, the capsule is, in some cases, a good deal thickened, and so much distended and enlarged, that it presses the iris forwards towards the cornea, thereby lessening the size of the anterior chamber of the aqueous humour. This pressure upon the iris causes the pupil to move very slowly, and to dilate very gradually by the application of belladonna, after which it does not speedily contract.

In these enlarged cataracts light is not admitted into the eye to the same extent as where the lens is of ordinary size. But in cases of fluid cataract, more especially when the fluid has opaque flakes floating in it, the state of the vision varies according to the position of these more opaque parts.

In congenital cataract both capsule and lens are generally opaque. The lens is generally fluid, and the anterior capsule of a bluish white colour.

(*e*) *Cystic Capsulo-lenticular Cataract.*—This term has been given to the cataract which is formed by the lens enclosed in its capsule being separated from its attachment to the ciliary zone and vitreous humour. It sometimes takes place spontaneously, but is more frequently the result of a blow upon the eye. When this separation occurs in a case in which there has been cataract previously, a spontaneous cure has taken place; a few rare cases of this kind are upon record. When the lens and its capsule are separated, lacerated, or dislocated by a blow, they soon become opaque.

In cases of cystic capsulo-lenticular cataract, the opaque body has, in some cases, a tremulous motion[1]; in other cases it floats about in the dissolved vitreous humour which surrounds it, quite unattached[2]. In other cases it is attached either to the ciliary zone or iris at one point of its circumference. Occasionally it falls forward, and either projects through the pupil into the anterior chamber, or passes into it completely, and produces inflammation of the cornea and iris.

When cystic cataract occurs spontaneously from disorganization in the vitreous humour, the eye is in general amaurotic also.

(*f*) *Siliquose Capsulo-lenticular Cataract.*—In this species of capsulo-lenticular cataract there is a diminution or entire absorption of the lens without a corresponding reproduction, the capsule thereby assuming a shrunk and wrinkled appearance. Hence this form of cataract has been compared to a shrunk seed surrounded by a withered husk.

A wound of, or blow upon the eye, by which the capsule and lens are penetrated or ruptured, gives rise to this form of cataract by the admission of the aqueous humour to the lens. By this the lens is dissolved, and its reproduction interrupted. Congenital cataracts are very often of this nature in consequence of the capsule having burst, and allowed the fluid lens to escape and become absorbed. (Whether it is possible for the lens to be absorbed without the agency of the aqueous humour, leaving the capsule shrunk, but entire, is a point yet undetermined[1].)

(*g*) *Bursal Capsulo-lenticular Cataract.*—"One of the rarest kinds of cataract, consisting in capsulo-lenticular opacity, combined with the presence, within the capsule, of a small cyst, filled with purulent matter, is styled *cataracta cum bursa ichorem continente.* This cyst has generally been found behind the lens, but occasionally in front of it.

"The opacity is orange; the iris sluggish; the posterior chamber obliterated by the pressure of the over-distended capsule; the perception of light indistinct; the whole habit of the patient weak and cachectic[2].

(*h*) "There is a cataracta gypsea, or a change of the capsule into a kind of cretaceous substance; it forms a thin kind of shell, brittle, and of a yellowish hue[3]."

(*i*) *Spurious or Adventitious Cataracts.*—Adventitious cataracts, or those consisting of opaque matter effused in the anterior chamber into the aqueous humour, and on the surface of the capsule of the lens, are of frequent occurrence. They are commonly of a whitish yellow colour, always the consequence of inflammation, and the matter effused, in some cases, becomes organized, so that red vessels appear upon it, and it frequently forms a connecting medium between the iris and capsule of the lens. Cataracts of this kind may occupy the whole of the pupil, or only a part of it. In many cases they are accompanied with a contracted state of the pupil, both being the result of the same inflammation. The sensibility of the retina to light also is often impaired from the same cause.

Several different genera and species of this cataract have been described, their names being derived from the nature of the effusion, or the form it assumes. Thus purulent, sanguineous, and pigmentous cataracts have been described, as also fibrinous, flocculent, clotted, and trabecular[4].

The pigmentous cataract is that which consists of a portion of the pigmentum nigrum, from the iris having become adherent to the anterior part of the capsule of the lens. This may have taken place either from inflammation of the iris, or from a blow on the eye, and it is most visible when the lens or its capsule has become opaque.

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[1] Cataracta tremulans.

[2] Cataracta natatilis, or swimming or floating cataract.

[1] Mackenzie, p. 653.

[2] Ibid. p. 654. [3] Lawrence, p. 407.

[4] Mackenzie, p. 655. Middlemore, v. 2. p. 190.

Cataracts have sometimes been classified according to their physical properties, viz. their consistence, size, and colour; circumstances which it is highly important to attend to in the diagnosis and treatment of this disease. Upon these we have already expatiated at sufficient length.

(*k*) *Congenital Cataract.*—The term congenital cataract is used to denote simply the date of the disease. The nature and appearances of such cataracts being similar to others which may have arisen from injuries or come on spontaneously.

§ 3. Duration and Development of Cataract.

The development of cataract is sometimes sudden, but it is more commonly slow and gradual. According to the imperfect or complete degree of the opacity, cataracts have been called *ripe* or *unripe*, *mature* or *immature*, for operation. Those being denominated unripe in which the opacity is not complete, and some degree of useful vision still remains. Those on the other hand have been called ripe when the opacity has become so complete that it is not susceptible of becoming greater, and has deprived the patient of useful vision.

After cataract has formed, it may continue to exist, and remain stationary in the eye for a long series of years, whether the opacity is partial or complete, and whatever may be the degree of the opacity. More commonly, however, cataract does not become stationary till the opacity has attained its most complete form, gradually becoming more and more opaque.

"Cataract is usually developed slowly, requiring some weeks, months, or years, for its complete formation; it may, however, come on quickly within a few hours. It seldom destroys sight completely, even in its perfect development. In many forms of cataract, a considerable degree of vision remains, and in the worst cases the patients can distinguish light from darkness if the retina be sound[1]."

Cataract from an injury generally takes place very soon after the infliction.

§ 4. Causes of Cataract.

Cataract is a disease which takes place from injuries of the crystalline lens or capsule. It is sometimes a congenital affection, but the most common form of it is that which takes place spontaneously. When it arises from an injury, it is usually confined to the eye injured; but, in the other cases, both eyes are commonly affected.

Injuries of the eye occasion cataract by the lens being either wounded, and acted upon by the aqueous humour, or by being detached from its vascular connexions, by which it loses its vitality[2]; and this may happen either from penetrating wounds or blows.

In most cases of spontaneous cataract, there are no symptoms indicating either unusual determination of blood to the eye, or of inflammation of the organ. In some cases, however, signs of plethora, both general and local, do exist during the formation of cataract; but whether the cataract is the consequence of inflammation, or merely happens as an accidental conjunction, it is not easy to say. We see so many instances of cataract without any signs of inflammatory action, that although it may be increased by this state, the cataract certainly does not depend upon it. "In many cases of cataract the direct cause of that particular change in the lens is unknown; neither do we know that any peculiar state of constitution is favourable to its development[1]."

Several predisposing circumstances have been observed to occur in cases of cataract. These, however, apply to the spontaneous cataracts of advanced life. 1. *Old age.* In which the lens always assumes an amber colour, which gives it a slight cataractous appearance. 2. *Hereditary tendency.* Cataract, like many other diseases of the eye, sometimes takes place in different members of the same family, and descends to their posterity, who become affected about the same period of life. 3. *Exposure of the eyes to strong heat.* Individuals who work much over strong fires, such as cooks, glass-blowers, blacksmiths, &c., are certainly more subject to this disease than others. 4. Great exertion of the eyes by candle, gas, or lamp light has appeared to me to predispose to cataract.

§ 5. State of the Iris and Pupil in Cataract.

In the early and imperfect stages of cataract, the iris and pupil continue in their natural state. They contract and dilate according to the degrees of light to which the eye is exposed. But when the cataract becomes more dense and more complete, less light being admitted into the retina, the pupil appears to be more dilated than that of a person whose eye is in a sound state; but in some cases it is more contracted. Its motions, however, continue unimpaired, provided the iris is not pressed upon by the cataract, and the other parts of the eye are in a sound state. A black ring or shadow is also generally observed around the margin of the pupil. In many cases this black ring is owing to the margin of the iris being of a dark colour, in addition to the space between the iris and lens.

The size and form of the pupil, together with the motions of the iris, are so much altered and affected in cases of cataract, complicated with other diseases of the eye, that they afford important indications as to the sound or unsound state of the organ.

When the pupil is much dilated, either by the obscurity of the light to which the eye is exposed, or the application of belladonna, a large black circle is observable around the lens. This circle is formed by the *zonula lucida*, or transparent space between the margin of the lens and ciliary circle. By dilatation of the pupil, cataractous patients generally have their vision much improved, so that they sometimes use belladonna daily for this purpose as a palliative remedy.

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[1] Lawrence, p. 397.

[2] See Watson's Compendium, 3rd ed. p. 310; also Med. Surg. Journ. vol. xxvi.

[1] Lawrence, p. 411.

The employment of belladonna in cases of cataract, to affect the pupil before examination of the eye, is attended with great advantage to the surgeon, and enables him to form a decided opinion in many cases which previously appeared to be doubtful. The variations in the conditions of the pupil will be again more particularly alluded to when treating of the complications and diagnosis of cataract.

If the iris be of a yellowish or green colour, not observable in the other eye, or is otherwise discoloured from previous inflammation, or if the iris has a tremulous motion when the eyeball or head is moved, the state of the eye may be considered unfavourable for the performance of any operation. If the pupil either dilates imperfectly, irregularly, or not at all by belladonna, the case is also unfavourable.

§ 6. State of the Retina in Cataract.

In many cases of cataract the sensibility of the retina remains unimpaired. But when the disease has existed for a considerable length of time, as for several years, the want of use seems, in some degree, to impair the functions of the retina; for, in many cases, after the most successful removal of the cataract, it is many weeks, and even months before the vision attains its most perfect state. But even though an eye has been blind for a great many years, either from cataract or closed pupil, perfect sight has been restored by operations for their removal. In one case of closed pupil, operated on by Mr. Guthrie, the patient had been blind from this cause for 22 years, and vision was restored so as to enable him to see to read very well[1]. In other cases, however, the vision restored is very imperfect after the removal of the cataract, from no other cause than a want of energy or power in the retina, probably from long inactivity[2].

§ 7. Complications of Cataracts.

Though cataract is a disease which may be entirely local and uncomplicated, yet cases of it are very frequently found to be complicated with diseases of other parts of the eyeball, as well as with morbid states of the system generally. We shall include the complications with other affections of the eye under four heads. 1. With opacity or disease of the other transparent parts of the eye. 2. With affections of the iris. 3. With affections of the retina; and, 4. With affections of the other coats and appendages of the eye.

The success of the treatment of cataract is much modified by these complications, and their existence always render success uncertain, or it may entirely forbid surgical interference, even in attempting a cure. "A perfectly uncomplicated case is very rarely met with. The following questions must evidently be of the highest importance, in every instance. Is the organ of vision in a condition to resume its office to any useful extent, were the cataract removed[1]? Is there nothing in the general health likely to frustrate the success of an operation, no local affection in any other organ of the body likely to sympathize with the eye and bring on inflammation?"

1. *Cataract complicated with Diseases of other Transparent Parts of the Eye.*

(*a*) *Specks of the cornea* are sometimes found to exist along with cataract. These are easily discovered by their superficial situation. They render cases of cataract more or less unfavourable for operation according to their situation and degree. If in the centre of the cornea, they render the case hopeless.

(*b*) The only other transparent part of the eye with which cataract can be complicated is that of the vitreous humour. Loss of transparency of this humour, or of its capsule, appears to be of very rare occurrence, and when it exists along with cataract it cannot be detected, unless it had been previously known to exist. The greenish deep-seated opacity which in many cases appears to be situated in the vitreous humour, is, I am convinced, from dissection and other circumstances, an opaque state of the retina, and constitutes *glaucoma*. (See Glaucoma.)

A disorganised state of the reticular membrane through the substance of the vitreous humour is not unfrequent. This makes the vitreous humour appear more fluid than natural, and sometimes gives rise to a moving or tremulous state of the lens. It is known by a soft state of the eyeball, waving or tremulous iris, and floating state of lens.

2. *Cataract complicated with Affections of the Iris.*

Many different states and affections of the iris are found complicated with cataract. The pupil is in some cases dilated; in others contracted. It may be found of its natural circular form, or very irregular in shape, the pupillary margin may be adherent to the capsule of the lens, either partially or wholly, or to some part of the cornea, thus permanently altering the dimensions and mobility of the pupil. The contractile motions of the iris, too, may be much impaired in cases of cataract, being often sluggish and irregular, and sometimes the mobility is entirely lost, its functions having been impaired by previous inflammation, or by palsy.

When the state of the pupil is not dependent upon adhesions between the iris and the lens, or cornea, or a permanent contraction of the pupil from previous inflammation, it (the state of the pupil) forms a tolerably nice indication of that of the retina. A dilated and sluggish state of the pupil being in general a sign of amaurosis or glaucoma, when that state of the pupil is not accounted for by the pressure of an enlarged lens upon the iris.

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[1] Guthrie's Lectures on the Eye, p. 200.

[2] Middlemore, v. 2. p. 284.

[1] Mackenzie, p. 659.

Adhesions between the iris and capsule of the lens, or permanent contraction of the pupil, may, in general, be ascertained by the application of belladonna to the eye. Upon the application of this medicine the pupil will only dilate at the non-adherent parts, and where the state of the iris is otherwise sound. Adhesions between the iris and cornea are easily discovered by inspection. They often exist when cataract has been caused by a penetrating wound of the eye.

Several of these affections of the pupil will necessarily prevent the patient from seeing so much light with the eye as he would otherwise do.

3. *Cataract complicated with Affections of the Retina.*

The most unfavourable complication of cataract, is that with disease of the retina or amaurosis, or with glaucoma, which we consider to be a modification of amaurosis.

In cases of cataract of greenish hue, with a dilated, misshapen, sluggish, or immovable pupil, particularly when the patient either cannot distinguish light from darkness, or can do so but very imperfectly; and when these symptoms are not accounted for by the enlarged size and complete opacity of the lens, or its capsule, the existence of amaurosis may be considered almost certain. This opinion will be confirmed, if symptoms of amaurosis were known to exist previously to the cataract, or if the patient has symptoms of amaurosis existing, such as pain in the head or eye, together with his seeing luminous, or black spots, or rings before his eye; or if the eye, having previously suffered from inflammation, is either enlarged or lessened in size, or has become preternaturally hard or soft to the touch. The existence of bluish spots upon the sclerotica or varicose vessels are also indications of an amaurotic state of the eye.

It is of great importance to become familiar with the different degrees of cataract which do not prevent patients from seeing to read. For, in doubtful and complicated cases, when the pupil appears to be natural, the diagnosis may often be formed by the degree of cataract present not being sufficient to account for the imperfect vision of the patient.

4. *Cataract complicated with Affections of the other Coats and Appendages of the Eye.*

Chronic inflammation of the coats of the eye occasionally exists in cases of cataract. Staphyloma of the sclerotic coat, from dropsical effusion within it, the consequence of previous inflammation, is not uncommon, but this is a state of the eye, as has been already mentioned, which is generally accompanied with amaurosis.

Different degrees of atrophy or diminution in the size of the eyeball, are sometimes observed in cases of cataract; a state of the eye by no means uncommon when it has suffered much from internal inflammation. In such cases the globe feels soft to the touch.

§ 8. Diagnosis.

The chief difficulty in forming a correct diagnosis in cases of cataract, arises from the liability to confound it with amaurosis and glaucoma. It is only in the incipient or early stage of the disease, that difficulty occurs; for it is then only that they resemble each other. In glaucoma, as well as in cataract, there is a slight opacity, having a greenish colour, situated behind the pupil. Though cataract and glaucoma, or amaurosis, resemble each other in some respects, particularly in appearance and impaired vision, yet, when minutely inquired into, other attendant circumstances will enable us to form a correct opinion. In cataract, the impaired vision usually takes place very gradually. At first the patient experiences difficulty only in discerning objects, as if he viewed them through a mist, and this increases very slowly and gradually; the degree in which vision is impaired bearing a proportion to the degree of opacity of the cataract; and, therefore, as the cataract increases, vision becomes more and more impaired. In amaurosis and glaucoma, on the other hand, the deterioration of vision takes place in general suddenly, is frequently partial, and dark or luminous spots are seen before the eye. The indistinctness of sight increases more quickly than in cataract, and often attains a more complete degree of blindness than ever occurs in cataract.

In cataract, also, the vision is in general worse in looking straightforward than in partial amaurosis, from the centre of the lens being in general most affected at the commencement of the disease. A cataractous patient, therefore, very often sees objects more distinctly, which are situated rather to one side, than when they happen to be directly before the eye. This last symptom, however, is equivocal, as in amaurosis patients very often see best with the side of the eye. There is a considerable difference in the state of the vision in cataractous and amaurotic patients, from the different degrees of light to which the eye is exposed. In cataract the patient sees best in an obscure dull light, from the dilatation of the pupil which then takes place; whereas in amaurosis, vision is best in a clear bright light, this being required from the diminished sensibility of the retina.

Cases of incipient amaurosis are in general accompanied with several other symptoms,—such as headache, flushing of the face, pain in the eyes, and derangement of the digestive organs,—symptoms which are rarely met with in cases of cataract, except where it is complicated with other diseases.

Upon a careful examination of the eye the slight opacity which is observed in glaucoma or amaurosis is of a greenish colour, deep-seated, and in general so slight that, to an experienced observer, it does not account for the degree of blindness of which the patient complains. When the pupil is dilated with belladonna, also, the lens may be seen to be quite transparent, vision is not improved, and the opacity which exists appears more distinctly seated in the situation of the retina.

In cataract the opacity is always of a whitish grey colour, and, when the pupil is dilated, the opacity is distinctly seated immediately behind the iris, and in the situation of the crystalline lens. Even when the posterior part of the capsule of the lens only is affected, the opacity, though deeper seated, is always striated, spotted, or radiated, but never uniform, as in glaucoma.

In cataract the opacity appears to be greater when the pupil is dilated; in amaurosis and glaucoma it seems to be less than it was before the dilatation.

The mobility of the iris and form of the pupil, when accurately observed, may assist materially in forming a diagnosis. In cases of incipient cataract, the form of the pupil is regular, and its motions are as lively and extensive as if the eye was not affected with disease. Whereas in amaurosis the pupil is sometimes dilated and of an irregular form, and it is either immoveable, or its motions are tardy and limited.

In cases of amaurosis there is a peculiar expression of the eyes easily recognized by an experienced observer. This consists in the patient having a vacant unmeaning stare without directing his eyes to any particular objects; and he does not readily direct the eyes to objects even when they are presented to him. In cases of cataract, however, these circumstances do not occur.

" The eyeball in glaucomatous amaurosis always feels firmer than natural, while in cataract it presents its usual degree of resistance to the pressure of the finger[1]." In glaucomatous amaurosis the eyeball I have often found also to be preternaturally soft.

Catoptrical exploration of the state of the lens as regards its transparency or non-transparency. This mode of exploring the eye, first invented by Professor Purkinje of Breslaw, has come into general notice only since M. Sanson published his clinical observations on the subject. " The young practitioner ought never to pronounce absolutely even on the existence of cataract without dilating the pupil by *belladonna*, and examining the eye *catoptrically;* and the most experienced may derive advantage from exposing in this way the whole field of the disease to his view, and testing the state of the crystalline[2]."

If a lighted candle be held before the pupil of a sound eye, three reflected images of it are seen situated one behind the other. Of these the anterior and posterior are erect, the middle one inverted. The anterior is the brightest and most distinct, the posterior the least so. The middle one is the smallest.

If the candle be moved, the two erect images follow it; but the inverted image moves in the opposite direction, though not so quickly and extensively as the other two.

The anterior erect image is produced by the cornea; the posterior, by the anterior surface of the lens; and the middle or inverted image is from the posterior surface.

If the whole crystalline body be opaque, no image but the anterior erect one from the cornea is seen. This is of course the case also if the anterior part alone be opaque; but if it is the centre or the posterior part only which is opaque, the two erect images are seen, but the middle or inverted one is not.

To apply this catoptrical method to assist the diagnosis of cataract, when the ordinary mode of examination may not have cleared away all doubt, " the observer and the patient should be placed in moderate day-light; the patient's back is to be turned towards the window; he should be seated, so that the observer may look rather down into the eye than upwards; and a candle is to be used which burns steadily, and does not blaze much.

" Cataract, even at an early stage, obliterates the inverted image, and renders the deep erect one very indistinct. Glaucoma, only when much advanced, obliterates the inverted image, while, in all its stages, it renders the deep erect one more evident than it is in the healthy eye."

Dr. Mackenzie has found that in glaucoma, at a middle stage, the inverted image is pretty distinct, when formed near the edge of the crystalline; but if the candle be brought in front of the eye, the inverted image is less distinct, and in some cases is altogether extinguished. This extinction of the inverted image is owing to a loss of transparency in the kernel of the lens which, in glaucoma, Dr. M. has found suffers a peculiar degeneration, characterized by dryness of substance, and a reddish brown colour.

In incipient lenticular cataract the inverted image, though changed neither in colour nor in size, is indistinct, and its outline as if washed off. It is extinguished long before the cataract is fully developed—a fact of the greatest importance, Dr. M. remarks, in the diagnosis betwixt glaucoma and cataract, because in lenticular cataract, it is not the kernel of the lens, but the superficial laminæ, which are first affected, so that the formation of the inverted image by any part of the posterior surface of the crystalline body is prevented.

" In capsulo-lenticular cataract, the inverted image fades much sooner than in mere lenticular cataract; and even when the capsule, or the superficial substance of the lens, seems to be alone opaque, the inverted image disappears much sooner than we should expect from the apparently moderate degree of opacity.

" In lenticular cataract, there is merely a general reflection, but no distinct image, from the anterior surface of the crystalline body.

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[1] Mackenzie, p. 639.

[2] Ibid, p. 642.

"If the lens is not in its place, but has been absorbed in consequence of an injury, been removed by an operation, or fallen down into a dissolved vitreous humour, neither inverted nor deep erect image is formed.

"In the diagnosis of incipient cataract and incipient amaurosis, the catoptrical test is perfectly decisive; for in amaurosis, uncombined with glaucoma, the three images are always distinct, while in even the early stage of cataract, the inverted image is obscure. The diagnosis of incipient cataract and incipient glaucoma requires the catoptrical test to be familiar to the observer, else he may not be able to distinguish, that when the candle is held in the axis of the eye, the inverted image is indistinct in both diseases, but whenever it is moved to one side, it becomes distinct in glaucoma, and remains obscure in cataract[1]."

§ 9. Prognosis of Cataract.

The prognosis in cases of cataract is very various, depending on the nature of the cataract, the age, and state of health of the patient, as also, upon whether or not the eye is otherwise sound.

Spontaneous cataracts, in most cases, continue to increase till they cause the loss of useful vision, while cataracts occasioned by injuries of the eye, particularly in young subjects, frequently become absorbed, so that a spontaneous cure takes place. Congenital cataracts either remain stationary in the eye, or, if they are fluid, and the capsule bursts, an absorption of the fluid takes place, and a shrunken opaque capsule remains. In some cases of spontaneous cataract, in adults, the opacity remains stationary for a considerable number of years, allowing the patient the enjoyment of a considerable degree of useful vision. But when the capsule is affected, the lens generally becomes opaque.

Cataracts may in general be removed by operations; but these operations, though successful in removing the cataract, may not restore the sight of the individual. For several morbid states of the eye, as well as changes produced by age, or the long inactivity of the organ, frequently frustrate success. The most important of these are a disorganized state of the vitreous humour and imperfect sensibility of the retina. From these causes, independent of the many diseased states of the eye with which cataract may be complicated, the vision of the patient is not improved by an operation, though completely successful, so far as the simple removal of the cataract is concerned.

There are also several dangers attending operations for cataract, which ought always to be kept in view, and prevent the practitioner from raising the expectations of his patient to the most sanguine hopes of recovery, which may never be realized, by the unforeseen circumstances which have occurred, and may again occur, in the hands of the most able surgeons. These consist, in inflammation, and other unfortunate consequences, arising from the constitution or conduct of the patient, and from accidents which may occur either during the performance of operations or sometime after.

It is not easy to say in what proportion operations for cataract are successful; for few cases are, either completely uncomplicated or attended with circumstances in all respects favourable for operation,—so that all operators are obliged to operate on many complicated and unfavourable cases, which may be followed by only a partial success; while in others, success was scarcely expected.

The prognosis, in cases of cataract, is to be considered favourable, when the disease is confined to the lens or capsule, provided the sensibility of the retina is undiminished, and the iris retains its healthy functions. The prognosis is most favourable in cases of congenital cataract in young persons, where it has arisen from injury, and in the uncomplicated lenticular cataract of advanced life. It is also of importance to our pronouncing a favourable prognosis, that the constitution of the patient be sound, his health good, and his habit rather spare than full: for, upon these circumstances, connected with the general health of the patient, the supervention of inflammation, or an escape from it, in a great measure depend. The two following cases illustrate this very strongly. From two individuals about the same age I extracted a cataract by the usual operation, and the circumstances of the cases seemed quite favourable. The one, however, was a glassblower, of a full habit, and had lived very intemperately for several years; the other was a female, who had lived on a milk and vegetable diet for several months on account of some internal complaint about the stomach or liver. In the first of these cases, *delirium tremens*, with furious delirium, came on the morning after the operation, and he died on the evening of the second day. The second case went on in the most favourable manner; no inflammation took place, not a red vessel appeared on the white part of the eye, and in ten days the eye appeared to be quite well and vision restored. In the first case the patient had been copiously blooded, yet on dissection the choroid coat was thickly coated with lymph; the other patient did not lose a drop of blood.

From what has been already said, it is scarcely necessary to enumerate the circumstances which, by their coexistence, render the prognosis, in cases of cataract, unfavourable. Some of these render the prospect of sight being restored extremely doubtful, while others render the cases almost hopeless; so much so indeed, that their existence ought to forbid surgical interference.

The circumstances which render the prognosis unfavourable are, a disorganized or fluid state of the vitreous humour, which is known by a softened state of the eyeball, a tremulous iris, contraction or adhesion of the pupil, symptoms of amaurosis, such as pains about the head, *muscæ volitantes*, and insensibility of the retina. When these last exist to a considerable degree, and more particularly when they are accompanied with either enlargement or atrophy of the eyeball, discoloration of the iris, or sclerotic coat, the cases may be considered hopeless, and unfit for operation.

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[1] Mackenzie, p. 640, 1.

Destructive inflammation of the eye is much more apt to take place after an operation performed upon persons advanced in life than in young subjects, and more particularly so in those of a rheumatic or gouty constitution. In cases where the sensibility of the retina is doubtful, an operation may be advised, the patient being at the same time informed of the exact state of his case, and allowed to decide whether he will rather submit to an operation of uncertain success, or remain in continued blindness.

§ 10. Treatment of Cataract.

It may be laid down as a well established principle, that cataract is quite incurable by any external application, or internal remedy, with which we are at present acquainted. Cataract causes blindness by intercepting and preventing the passage of the light to the retina, the other parts of the eye being entire. But as the crystalline lens and its capsule are not indispensable to distinct vision, they may be removed from the axis of the eye, without the sensibility or usefulness of the organ being impaired. The removal of these parts, therefore, when they become opaque, either from the axis of vision or out of the eye altogether, becomes desirable for the restoration of sight. Accordingly several surgical operations are practised for the removal of cataracts, by which the patient is restored to sight.

A spontaneous cure of cataract by absorption may be said to take place in those spurious or adventitious forms of the complaint, which arise from recent inflammatory effusions on the surface of the capsule of the lens. This may also happen in cases of cataract from injury where the capsule has been ruptured, so that solution and absorption of the lens take place by the agency of the aqueous humour. By a blow upon the eye likewise, an opaque lens and its capsule may be detached from their connexions, and removed from the axis of vision. In other more rare cases, where the lens has become detached from its connexions, in consequence of disorganization of the vitreous humour, and has fallen from the axis of vision a spontaneous cure has also happened. M. Boyer mentions an interesting case of a gentleman, who, after twenty-five years blindness, his eye having been considered unfit for operation, suddenly had his sight restored when walking along the street, the detachment of the lens above described having taken place at its upper half, by which it waved to and fro in the eye[1].

All operations for cataract have for their object the removal of the opaque body, whether consisting of capsule or lens; but even if the crystalline lens be transparent, it also must be removed; for it would immediately become opaque after any operation upon its capsule.

Cataracts may be removed from the axis of the eye in three different ways: 1st. They may be depressed or removed from their situation into the vitreous humour,—an operation which is termed *couching*, or the *depression* of cataract. 2d. The cataract may be lacerated and broken to pieces, in order to cause it to be acted upon by the aqueous humour, by which its solution and final absorption are accomplished. This is termed the removal of cataract by *solution* or by *absorption*. 3d. Cataracts may be extracted or completely removed from the eye, and hence this is termed the removal of cataract by *extraction*.

Each of these operations for the removal of cataracts may be performed in various ways, and by different instruments, each of which have, at different times, had their several advocates and opponents. When properly performed, and under favourable circumstances, each of them may be equally successful in effecting a cure; but they are not equally well suited to every case. The operation best adapted to one class of cases, may be quite inadmissible in another. The operation by absorption, for example, is the best suited to cases of soft or fluid cataracts; while, in such cases, the operations of couching and extraction are quite inadmissible. Hard cataracts may be removed either by depression or extraction, though not by absorption; but there may be circumstances attending individual cases, which may make one of these operations inapplicable, and cause the other to be preferred.

Cataracts can be properly treated, therefore, only by the judicious and proper selection of that operation which is known to be best adapted to the nature and circumstances of each individual case. Thus a complete knowledge of the different operations for cataract, and the adaptation of them to individual cases, becomes indispensable to every one who would practise properly this branch of surgery.

Before proceeding to describe the various operations for the removal of cataracts we shall make a few remarks on the preliminary questions which occur after having ascertained the nature of the case and kind of cataract which is present.

§ 11. Remarks on Preliminary Questions regarding the Treatment of Cataract.

1. *Should an operation be performed if one eye only is affected?*—When both eyes are affected with cataract, it is the common practice of operators to perform an operation either upon both, at the same time, or upon one at first, and the other afterwards. It may therefore be thought remarkable that there should be any question or difficulty as to the pro-

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[1] Malad. Chirurg. vol. v. p. 509.

priety of operating when only one eye is affected; for this circumstance, however, the difference as to the focal point of vision, caused by the removal of the lens, affords some explanation. If the lens has been removed from one eye, while it remains in the other, the focus of vision becomes very different in the two eyes; the eye from which the lens has been removed, requiring the use of a convex glass to make up the deficiency, in order to restore its former refracting power. The most common rule of practice has been only to operate in cases of spontaneous cataract after both eyes became affected. It has been alleged by some[1], that the removal of a cataract from one eye prevents the disease in the other; and when it has commenced in the other, has the effect of arresting the progress of the opacity. This has, however, not been confirmed by the observation of others, and we very frequently see one eye affected with cataract for a long period of years without the other becoming affected.

In the cataracts of young persons, which are in general easily removed by a slight operation, and particularly in females, where it is often an object to remove the deformity, we conceive there can be little doubt as to the propriety of performing an operation[2]. After a successful operation in such cases, though the focus of sight may not correspond with that of the other, yet deformity is removed, and the sound eye is much assisted by the vision of the other being restored. But by the proper adaptation of glasses the vision of both may be made to correspond in seeing minute as well as distant objects.

As to operating upon elderly persons where one eye only is affected with cataract, the case being somewhat different, requires to be considered in another light. Inflammation being more likely to supervene after an operation on an elderly than a young person, this may affect the other eye, and do material injury to it. The restored vision, also, not corresponding with that of the sound eye, and the material injury to the general health, which is sometimes occasioned by the after treatment, are reasons which render it a well founded general rule, not to operate upon one eye till the patient has become deprived of useful vision with both.

From this last general rule, however, there may be cases of exception; as where the patient is not very far advanced in life, and where he is anxious to have the cataract removed. For, by the continued exclusion of the light from the retina, this nervous expansion not only loses its vigour and sensibility, but the individual also loses the power of directing his eye to particular objects. Besides, cataract might, and very probably will, affect the other eye of the individual at a subsequent period; and possibly at such an advanced age, that it would both be extremely inconvenient and hurtful to his general health to perform an operation upon either eye. In such cases, if one eye had been operated on at an earlier period, the patient could not have been reduced to this predicament.

2. *When is the proper time for performing an operation?*

Regarding this question there is no room either for doubt or difficulty; and, accordingly, it is quite an established rule of practice, never to operate on an eye affected with cataract till the patient has been deprived of all useful vision with the eye affected. Previously to this it would be improper, as the patient might be deprived of the vision he had by the operation being unsuccessful. Any degree of vision, therefore, however little, would be better than the risk of an unsuccessful operation; more especially if the other eye is irrecoverably blind.

3. *Should both eyes, when equally affected with cataract, be operated on at one and the same time; or should one be operated on first, and the other at a subsequent period?*

Upon this question there has been a considerable difference of opinion. Some surgeons recommend operating on both eyes in all such cases, and whatever operation may be adopted; while others operate on both eyes at once when they operate with the needle; but on one eye only when they operate by extraction. A third, and more cautious class of operators recommend, that in all cases only one eye should be operated on at once.

Probably the middle course, which is adopted by those who operate on both eyes, if the needle is employed, and on one only by extraction, is the best rule which can be followed. But though we conceive that it would be placing the sight of the patient in unnecessary hazard to perform extraction on both eyes at the same time, which would not in general be the case when operations are performed with a needle, yet there may be cases in which it would be better to operate only on one at a time. As for example, in an individual of an inflammatory diathesis, which not having been anticipated, might be discovered too late for saving even one of his eyes; whereas, if one only had been operated on at first, its loss would lead the surgeon to the most effectual precautionary measures against inflammation before operating on the second. In cases of the lower orders, too, when not treated in a public hospital, the individuals are liable to the injurious consequences of mismanagement, and the employment of improper stimuli over which the medical attendant has little control: it would be better to operate only upon one eye than on both at the same time. The chief reason for operating on both at once, seems to be the advantages derived from saving time and anxiety to the patients, and preventing the necessity of farther weakening the constitution by a second application of the necessary antiphlogistic treatment. The strength of these arguments must be considered when applied to individual cases which come before the practitioner.

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[1] Himly, Beer.

[2] It may be mentioned as further evidence of the necessity of operating on young persons when the cataract exists only in one eye, that if the disease be allowed to continue, it is likely to occasion squinting, and to become converted into that form of capsular disease which is considered by all writers on the subject to be so difficult of management. This point has been fully treated by Mr. Middlemore in a paper published in the Med. Gaz. for August 1, 1840.

In cases of congenital cataracts operations may in general be performed on both eyes with safety, when the patients are young, and under proper management, even at the age of only two or three months. The period of teething for such operations, however, should be avoided.

There is an advantage in some cases derived from our operating upon one eye only at first, in consequence of our acquiring by it certain information both regarding the nature of the cataract, the constitution of the patient, and the effect of the operation performed; which may be highly useful to us in selecting the operation and conducting the cure of the other eye.

4. *Should the patient undergo any particular preparation, before undergoing an operation for cataract?*

The effect of an operation most to be guarded against, is inflammation of the eye, from the wound it must necessarily receive. A more than ordinary disposition to inflammatory action in the system, therefore, is to be carefully obviated before the operation. If the patient is of a full and plethoric constitution, and more particularly when of intemperate habits, an antiphlogistic regimen, preceded by bleeding and purging, requires to be enforced for several weeks or months. The necessity for this, and the good effects which result from a spare and anti-plethoric state of the system, are strongly illustrated by the two cases, already mentioned in section ninth. These, no doubt, are extreme cases, selected for the sake of contrast; but others, followed by similar results, though in a less degree, are not uncommon. It may also be remarked that, in individuals strongly disposed to inflammation, it is not material what operation is adopted; for the inflammation following operations with the needle, proves sometimes as violent and destructive as that subsequent to extraction.

But where the patient is in good health, of moderate fulness, and of temperate habits, no preparation is required, farther than a moderate diet for a short time previously, and some purgative medicine on the day before the operation.

From symptoms of fulness of blood about the head, or the patient being of a full and plethoric habit, it may be necessary, in some cases, to subject the patient to a moderate bleeding before the operation. If there is any derangement of the digestive organs, as indicated by foulness of tongue, and other symptoms, this state must be corrected by proper remedies before the patient is operated on.

Individuals affected with or liable to catarrhal, rheumatic, gouty, or other inflammatory diseases, should not be operated on in spring when this can be avoided, as an attack of any of these might aggravate inflammation of the eye, and prevent the success of an operation[1]. Persons otherwise healthy, and not subject to the diseases above mentioned, may be operated on at any season.

5. *At what age should those affected with Congenital Cataract be operated on?*

This question has been decided by the profession, that they should be operated on during infancy. The eyes of children affected with congenital cataract, acquire a rolling tremulous motion, which is either obviated or prevented by an early operation. In 1811, the late Mr. Gibson of Manchester communicated to the public[2] his experience in the use of the couching needle in infants, after having fully ascertained that the age of five or six months is more favourable for operating than that of two years or any subsequent age. The late Mr. Saunders, of London, also, by experience and accurate observation greatly extended our knowledge of this subject. He came to the conclusion, that the most favourable time for operating, is when the child is between 18 months and 4 years of age. He found that after this age the rolling motion of the eyes became more inveterate and inconvenient to the patient, and that the retina faded in power for want of use[3]. Mr. Tyrrell thinks the operation should not be delayed beyond the third month.

§ 12. Operations for the Removal of Cataract.

It has been already remarked, that operations of three kinds are practised for the removal of cataracts; viz. those having for their object or principle the depression of the lens from the axis of vision, the extraction of the lens, and the removal of the lens by solution and absorption.

Before proceeding to describe particularly these operations, it will be proper to make a few remarks upon the position and duties of the patient, the operator, and his assistant; for upon the proper conduct of each of these the success of operations greatly depends. The want of composure and steadiness on the part of the patient, the ignorance or awkwardness of an assistant, may in an instant have the effect of defeating the success of the most dexterous operator.

The patient may be either seated upon a chair or stool, of the height most convenient for the surgeon, or he may be laid horizontally upon a couch. When seated upon a chair, the operator sits or stands before the patient, when operating upon the left eye;

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[1] Mr. Middlemore suggests that before operating by extraction on a gouty person, an issue should be placed in one or both arms, v. ii. p. 120.

[2] Ed. Med. Surg. Journ. vol. vii. p. 394, 1811.

[3] See his Treatise, edited by Dr. Farre, pages 175, 176. London, 1811.

but if operating upon the right, he requires to stand behind the patient, if he is not ambidexter. If the patient reclines, the surgeon sits or stands by his side when he operates upon the left eye; and stands at the back of his head when operating upon the right, unless, as in the preceding case, he is to operate with his left hand, when he will stand on the right side of the patient.

The patient must be cautious to keep his eye as steady as possible, but to do so without straining. All that is wanted is, to keep the eye at rest, and avoid moving it; if much effort is made by the patient to keep the eye steady he may make injurious pressure upon it with the muscles. He requires to be cautioned also against suddenly raising his hands when they are not held by assistants.

Some operators have recommended, when performing an operation for cataract, that the other eye, if it has any vision, should be closed to exclude the light; while others are of opinion, that exercising the sight of the other eye in directing it to some particular object, or to the face of the operator, is the best mode of keeping the eye operated on steady. It is not of much consequence which of these is adopted. When the patient retains a considerable degree of vision in the eye which is not to be operated upon, it may either be tied up or left uncovered during the operation. There can be no harm in leaving the eye uncovered, and it is attended with this advantage, that it enables the patient to direct the eye to be operated upon to some fixed object, by which it is steadied and placed in a proper position at the commencement of the operation. This might be accomplished were the other eye tied up, but in many cases not so well.

The duty of the assistant is to hold the head of the patient steady, and prevent it from moving, as well as to hold one of the eyelids open, by pressing it with the points of one or two fingers of one hand to the margin of the orbit. In doing so, however, he should be careful to make no pressure upon the eyeball with a view to steady it, as this must only be done by the operator himself. The other hand of the assistant is to be employed in keeping the head of the patient steady. The operator himself is to keep the other eyelid of the patient open with the two first fingers of the hand not employed in operating. In doing this his fingers are also to be employed in keeping the eyeball steady, by a degree of pressure regulated according to circumstances.

Various kinds of specula, hooks, &c. were formerly employed in keeping the eyelids open and fixing the eyeball: these have now been almost entirely laid aside; the points of the fingers being found infinitely preferable. Some very dexterous operators, indeed, are even in the habit of performing operations for cataract without any assistant, by simply employing the fingers of the hand not employed in operating, to keep the eyelids and eyeball in their proper position.

The operations for the removal of cataract have undergone many changes, both as to the different modes of accomplishing them, and the instruments employed. They may now be considered to have attained a very high degree of perfection in these respects. No one of these operations can by any general rule be adopted for all cases; for it will be afterwards seen that each of them has its advantages and disadvantages in particular cases; so that the operation requires to be selected and performed according to the nature of the case. The success of operations for cataract depends not more on the dexterity with which it is accomplished, than in preventing subsequent inflammation of the eye. It is, therefore, of great importance, before proceeding to perform an operation for cataract, to ascertain particularly the state of the patient's general health, and his liability to inflammatory disease.

It is impossible to form a comparative estimate of the success of the different operations for cataracts:—1st. Because individual operators may not perform each of the operations equally well. 2d. Each of the operations has its peculiar dangers, which may unfortunately happen more frequently in the hands of one than another, even although equally dexterous. 3d. Because cataracts vary so much in their nature in different cases. 4th. Because of the different circumstances of patients as to age, sex, constitution, habits, general health, &c. 5th. Because one operation is the most suitable for some cases, while it would be improper in others. 6th. Because of the complications and unfavourable concomitant circumstances which occur in almost every case, but presenting themselves in almost endless variety and modifications, without forbidding the performance of an operation[1].

The proper treatment of cataract, therefore, will depend on the proper selection of the operation most suited to the particular case, its successful accomplishment, and the prevention of inflammation.

§ 13. First Operation for the Removal of Cataract, Displacement, Depression, Couching, and Reclination.

The depression or couching of the cataract by displacing it from its natural situation into the lower part of the vitreous humour where it is removed from the axis of vision, is the first operation which was performed for this disease.

The description of Celsus is the first which we have of the operation of couching the cataract, and his directions are nearly as perfect as those which can be given, even with the addition of the subsequent experience since his time. The Hindoo native Indians also appear to have practised an operation for the removal of cataract, probably from an earlier period than the time of Celsus, but no account of this operation was published till a very late period by Dr. Scott in the Journal of Science and Arts, No. 3.

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[1] Estimating the success of different operations by the comparative success of those operators who have published their experience is very fallacious, as many of the greatest operators have never published the result of their practice.

Several distinct modifications of this operation require to be described; viz. 1. Simple depression of the lens and capsule by a needle, introduced through the sclerotica or through the cornea. 2. Depression of the lens with laceration of its capsule, &c. 3. Reclination of the lens. Each of these operations may be performed by introducing the instrument for the purpose either through the sclerotica and behind the iris, or through the cornea and anterior to it.

The different operations for the displacement of the cataract, are performed by means of a small pointed instrument called a couching or cataract needle.

The cataract needles now in use are few in number, and of simple construction. Dr. Ammon of Gottingen, however, in a small work on the operations for cataract, has published a plate containing 77 figures of needles; these, for the most part, differ from each other, though they may be said to have a general resemblance. He has commenced with that of Celsus, and delineates the different needles of subsequent distinguished operators of different countries down to that of Pott and Hey in England. It is unnecessary, and would serve no useful purpose to enter minutely into a detailed account of all these needles. We shall confine ourselves to a description of the needles of Beer, Scarpa, and Buchhorn, the whole of the others being almost entirely laid aside. These needles have nearly the same properties, except that one is straight at its point, whereas the other two have different degrees of curvature. Each of them is a little more than an inch in length, flattened and lance-shaped near the point, with sharp cutting edges. (See figs. 15, 16.) With these needles almost every useful object can be attained; and the other needles, which have been invented and used for similar purposes, may be said to possess the same properties with slight modifications. The first is the straight lance-pointed needle of Professor Beer, fig. 15. This needle, like the others, is a little more than an inch in length, and fixed in a handle. Its thickness is about $\frac{1}{20}$ part of an inch, tapering from the handle to the point, where it becomes flattened, sharp-edged, and pointed. This needle may be used for any of the operations for cataract which can be performed by a needle. The second is the curved needle of Scarpa, fig. 16. It is of the same dimensions as the preceding, but is curved at its point to the extent seen in the plate, and the curved part at its point being of a triangular form, instead of being either round or flat. This needle is used chiefly for the depression of the lens and tearing of its capsule, for which purposes it is well adapted. The needle of Buchhorn is similar to that of Scarpa, but more flattened and less curved at its point. It has been invented and employed chiefly for the breaking to pieces of the lens in the operation through the cornea, called *Keratonyxis*.

The handles of the needles are made of wood or ivory, and marked on the two sides, corresponding to the sharp edges of the point. The handles are generally about four inches long, and eight-sided.

The figures here introduced represent these needles of the ordinary size, but in the cases of children they should be smaller. Some surgeons have recommended needles of a much smaller size, particularly in diameter; and Dr. Jacob of Dublin has recommended small curved needles made of small round common sewing needles in preference to any other. Fig. 17. By using very fine needles it is doubtful whether any advantage is gained, and in some cases sufficient power cannot be exerted with them to tear open or depress the lens.

When needles are made flat near to their points, the sides of the flat part should have a sharp cutting edge like a lancet, in order that it may easily penetrate through the coats of the eye; but the length of this flattened part should not be more than $\frac{1}{8}$ of an inch, so that the needle may be easily turned round when in the eye.

There are two modes of couching or depressing the lens, viz. the partial and the complete displacement of it. The former is called reclination of the lens, see fig. 22, *b*, the other depression of it, see fig. 22, *c*. Both of these operations, or different degrees of displacement, may be performed by introducing the needle either through the cornea anteriorly to the iris, or through the sclerotica posterior to it. See fig. 21. But as in each of them the laceration of the vitreous humour, where it is to receive the lens imbedded into it, is essential to the permanent displacement of the cataract, this can be much better accomplished by the needle when it is introduced into the eye through the sclerotic coat, and behind the iris, than before it.

Previously to any operation for cataract with the needle, the pupil is to be dilated by extract of belladonna, smeared over the eyebrow and lids some hours before the time of operating. This gives the operator a great advantage in seeing the operations of the needle upon the cataract. The first part or stage of the operation for the displacement of the lens, is the introduction of the needle through the coats of the eye. When the needle is introduced through the cornea, it ought to be inserted at the distance of a line and a half or two lines from the margin of the cornea. When it is introduced through the sclerotic coat, it ought to penetrate into the eye at the distance of one and a half or two lines from the margin of the cornea, and it should be made to penetrate a little either above or below the transverse diameter of the eye, with its cutting edges directed anteriorly and posteriorly to avoid wounding the long ciliary artery and ciliary nerves[1]. Injury of the iris is also to be carefully guarded against by turning the flat side of the needle towards it whenever it has penetrated through the coats of the eye.

These operations may each be divided into three stages. 1st. The introduction of the needle into the eye; 2d. the displacement of the cataract; and 3d. the withdrawing or removal of the needle from the eye.

1. *Displacement or depression of the Lens through the Sclerotica.—Couching and Reclination.*

This operation is performed with one or other of the needles above described; and the great object to be kept in view is, to displace the lens and imbed it in the vitreous humour, so that it will not reascend, and will be out of the axis of vision. Simply to depress the lens till it reaches below the pupil is not a proper or sufficient displacement of it. This would be wrong in principle, and found unsuccessful in practice.

The needle is to be held like a writing-pen, having one of its cutting edges directed towards the cornea, the other towards the posterior part of the eye. When the eye has become steady, it is to be retained in its position by gentle pressure made upon it with the points of the fore and middle fingers, which are also employed in keeping the eyelids open, placing the middle finger upon the lacrymal caruncle, which prevents the eye from turning in towards the nose. The needle is now to be introduced through the conjunctiva, sclerotica and ciliary zone into the posterior chamber of the aqueous humour, at the distance of about a line and a half from the margin of the cornea, and having its point directed to the centre of the vitreous humour. Whenever it has penetrated through the coats of the eye, the needle is to be turned a little upon its axis till the direction of the cutting edges is changed to that of upwards and downwards, parallel to the flat surface of the iris. By this movement the risk of cutting the iris with the needle is avoided. Fig. 21 represents the needle introduced through the coats of the eye, with its point advanced to the front of the lens.

If the needle is introduced at a greater distance from the margin of the cornea than above specified, the retina will be in danger of being wounded; if, on the other hand, it be introduced nearer to the cornea, the ciliary processes and iris may be injured.

Whenever the needle, introduced as above, has penetrated to the depth of about $\frac{1}{5}$ of an inch, or as soon as its lance-shaped part has reached the centre of the lens, the first stage of the operation may be said to be completed.

Second stage—This stage, or the displacement of the lens, is effected after pushing the needle gently onwards into the posterior chamber of the aqueous humour, between the iris and lens, so that its point becomes visible in the pupil. In doing this, if the needle employed has a curved point, its convex part should be turned towards the iris, its concave part towards the lens, by which injury to the iris by the point of the needle will be prevented. The point of the needle is now to be placed upon the upper and anterior part of the cataract by depressing its handle. When the point of the needle has been placed on the proper part of the lens, the handle of it is to be moved upwards and forwards, by which the lens will be depressed into the vitreous humour, downwards, backwards, and towards the temporal side of the eye, nearly to the place between the insertions of the abductor and depressor muscles, and having its flat side laid towards the lower side of the eye. The situation of the lens, when so depressed, is shown in figure 22, *c*, as removed from its natural situation at *a*.

When the handle of the instrument has been elevated somewhat above the horizontal, the cataract has been sufficiently depressed. If the depression was carried farther, the retina and choroid coat might be injured, and blindness from this cause produced.

In performing this part of the operation, it is necessary that the lens be introduced into a breach of the vitreous humour, formed either by the lens itself pressed into it, or by the needle before depressing the lens. If the lens is not imbedded in a breach of the vitreous humour, and is only depressed between the ciliary zone and the hyaloid membrane, or between the choroid coat and the retina, it will either produce hurtful inflammation of the iris, retina, and choroid coat, or will reascend into its former position. After the lens is depressed, it should be retained in its new position by keeping the point of the needle upon it for a short time, perhaps about a minute, a practice which has been recommended to prevent its reascending.

Another mode of performing this stage of the operation for the depression of the lens, is to introduce the needle to the posterior part of the lens, and make a transverse opening in the middle of the posterior part of the capsule. The point of the needle is then to be carried over the upper edge of the lens, which may be done without injuring the ciliary processes, on account of the space I have shown to exist between them and the lens, placed on the upper and anterior part of the lens reaching to the opposite side of it, and the lens depressed into the vitreous humour, through the opening made in the posterior part of its capsule, by moving the handle of the needle upwards and forwards. The lens will then be placed in the vitreous humour below the axis of vision, and having its posterior surface downwards, the anterior surface upwards. After this is accomplished, the point of the needle should be brought forward to lacerate the centre of the anterior part of the capsule, if it still remains entire, that secondary capsular cataract may be prevented, as recommended by Scarpa.

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[1] The direction to introduce the needle either above or below the transverse diameter of the eye is that which is almost universally given; but if the description of the long ciliary arteries by Mr. Wharton Jones, viz. that they run "in the direction of the equator of the eyeball, sometimes, however, a little higher, sometimes a little lower," and that "at about a quarter of an inch from the iris they divide at an acute angle each into two branches, an upper and a lower*," be correct, it is obvious that the surest way to avoid the branches of the artery is, as Dr. Mackenzie directs, to enter the needle exactly in the equator of the eye.—Ed.

* Mackenzie on the Eye, 3d ed. p. xxv.

Third stage.—The cataract having been depressed, the point of the needle is to be elevated, and gradually withdrawn from the eye in the same manner in which it was introduced, care being taken to observe whether or not the lens rises again along with the needle before it is withdrawn from the eye, in order that if it does, it may be again depressed.

The removal of the capsule, as well as the lens, from the axis of vision, is to be desired in this operation, to prevent a secondary capsular cataract from supervening. In some cases it is depressed along with the lens, fig. 27, but in other cases it remains merely torn, fig. 28, and the remaining portions of it being elastic, become so contracted that they do not obstruct vision. But the point of the needle may in all cases be turned towards the cornea before withdrawing it, and turned round in the pupil upon its axis, by which the division of the capsule will be accomplished if it still remains *in situ*.

The *reclination*, or partial depression of the lens, is performed precisely in a similar manner to the couching or complete depression of it, except that when the point of the needle is placed upon the upper and anterior part of the lens, in order to depress it, the handle of the needle should be elevated forwards and upwards, so that the point of the needle may be pressed backwards in effecting the depression. By this operation the anterior part of the lens becomes the superior, and the posterior the inferior part. This new position of the lens is shown in fig. 22, *b*, having been removed from its natural situation *a*.

By this operation the lens is placed below the axis of vision, and being imbedded in the vitreous humour, does not in general rise from this situation.

In performing these operations for the displacement of the lens, care must be taken not to transfix or spit the lens in introducing the needle into the eye, by which it would be prematurely displaced, and the motions of the needle embarrassed: from this situation it is necessary to disentangle the needle by being partially withdrawn. When the lens is prematurely loosened from its situation it is very difficult either to break it up or to depress it. In depressing the lens, if the pupil is pulled to one side so as to render it oval, the lens will be adhering to the iris, and must be separated. If the lens has been unexpectedly found to be soft, so that the needle passes through it in place of depressing it, the anterior part of the capsule is to be freely lacerated to admit the aqueous humour, that the lens may be removed by absorption.

2. *Depression and Reclination through the Cornea. Keratonyxis.*

The partial and complete displacement of the lens above described may be accomplished by introducing the needle through the cornea. But in this method the operator does not possess the same command over the cataract which he has when the needle is introduced through the sclerotica. He cannot detach and displace the lens so well, and is in greater danger of injuring the iris with the needle. This mode of operating, therefore, for the displacement of cataract is not generally practised.

The reclination of the lens may be performed by introducing the needle through the cornea, which answers equally well as if introduced through the sclerotica. But the risk of inflammation and opacity of the cornea in the situation of the wound, which might extend and interrupt vision, forms a strong reason for giving a preference to the introduction of the needle through the sclerotica. This mode of operating through the cornea has been called Keratonyxis, and was first practised about the end of the eighteenth century.

A curved needle is to be introduced through the lower part of the cornea, at the distance of about a line from its margin, and having its concave side directed upwards, the convex side downwards. It is to be pushed quickly forwards till its point reaches the cataract; the convex part of the needle being now raised and placed upon the anterior and upper part of the lens, it is to be depressed, by raising the handle of the instrument.

The lens will now be imbedded in the vitreous humour, and if it should rise on withdrawing the needle from it, the movement for its depression must be repeated, and the needle retained upon it for a short time.

3. *Depression of Cataract as practised by the Native Indians.*

The depression of cataract into the vitreous humour, by a mode peculiar to themselves, seems to have been long practised by the native Indians in Hindoostan. These operators have no pretensions to any knowledge of anatomy or surgery; they are itinerants, who devote themselves to this operation solely; and their mode of operating descends from father to son.

This operation of the native Indians consists in their forming an opening through the sclerotica and coats of the eye, at a small distance from the margin of the cornea, with the point of a lancet; a blunt-pointed needle, of a triangular form at its point, is then introduced, by which the lens is depressed into a breach of the vitreous humour.

The success which has attended this operation for the removal of cataract by the native

Indians, appears to be equal to that of the most experienced surgeons. It is a rude operation, in the performance of which the different parts of the eye are much more injured than in operations with the common couching needle of modern surgery; and the success which has attended it is, probably, not a little owing to the simple and abstemious mode of life which is general among the natives of India[1] in preventing subsequent inflammation.

§ 14. Removal of Cataract by Division and Absorption.

The removal of cataract by solution and absorption is founded on the fact of the crystalline lens being removed from the eye in cases where its capsule has been laid open, by which the lens is subjected to the action of the aqueous humour.

In order that the opaque lens be removed by this process, it is necessary that it be freely exposed to the action of the aqueous humour by its capsule being laid open. The process, however, is much accelerated by the lens being broken into fragments, and part of them placed in the anterior chamber; it is also quicker the softer the consistence of the lens is. Hence it takes place much more quickly in young subjects than in those advanced in life.

This operation is performed by means of needles similar to those already described for the displacement of the lens. The operation may be performed by introducing the needle either through the sclerotic behind the iris, or through the cornea; the point of the needle being then applied to the centre of the lens, is to be employed in lacerating and cutting as much of the anterior part of its capsule as possible. The division of the capsule, however, must neither be too great on the one hand, by which the lens might be dislocated, and pass into the anterior chamber entire, nor the laceration too limited, after which the wound on the capsule might close and adhere; so that the aqueous humour would not be admitted to the lens.

The intention of this operation at first, is simply to lacerate the anterior part of the capsule without displacing the lens from its situation. When this is accomplished, if the lens be very soft or fluid, it passes into the anterior chamber, and renders the aqeuous humour turbid; it then becomes dissolved and absorbed with the aqueous humour.

This operation causes so little injury to the eye, that it may be repeated once, or oftener, at intervals of two or three weeks.

By these subsequent operations the lens is to be broken into fragments, and part of them pushed forwards into the anterior chamber, in order that they may be more readily acted upon and absorbed. See fig. 8.

This mode of removing cataracts is more particularly adapted for fluid and soft cataracts. In cases of congenital cataract, and those of young persons from injury, it is also the most suitable. It is a more slow and gradual mode of removing a cataract, so that several weeks or months may elapse before vision is restored, and that only after three or four repetitions of the operation, where the cataract is of a firm consistence; but it is less dangerous to the eye, and in favourable cases as effectual in producing a cure as any other operation.

When the cataract is fluid the clearness of the aqueous humour and pupil will be restored in a few days after the operation. The removal of the cataract in other cases depends on its degree of hardness and the age of the patient, as well as the number and situation of the fragments into which it is broken: the softer the cataract the more quickly is it absorbed. In young persons, and in those under 30 years of age, it is more quick than in older individuals; and the absorption takes place more quickly when the portions are placed in the anterior chamber, and the more the cataract is subdivided.

Inflammation following this operation retards the solution and absorption of the lens, which process does not proceed till the inflammation has subsided. What has lately been called *drilling* a cataract, is just a modification according to particular circumstances of this operation.

§ 15. The Extraction of Cataracts.

1. *Extraction through an incision in the Cornea.*

The removal of cataracts from the eye by a section of the cornea was first practised as a regular operation about the middle of the eighteenth century, and the merit of it is usually ascribed to a French surgeon named Daviel. This operation has been perfected, by the repeated improvements which have been suggested since the time of Daviel. The following is the mode of operating which is generally considered the best.

The first part of this operation consists in making an incision through the cornea for the exit of the lens. The most simple mode of accomplishing this is by means of a knife introduced through the cornea.

The knife at present in general use, at once the most simple and the best adapted for the purpose, is that which has been improved by Professor Beer of Vienna, and which, therefore, is commonly known by his name. This is a triangular-shaped knife, about one inch and a quarter in length, and about four-tenths of an inch in breadth at its broadest part, (see fig. 18). As it gradually increases in breadth and thickness from its point backwards, it fills up the opening which it forms when pushed into the eye; thereby preventing the escape of the aqueous humour before its exit from the eye when the incision is completed.

The knives formerly used in this operation were more of a lancet shape, and by some operators were only used in making a puncture through the cornea, the incision being afterwards enlarged to a sufficient extent by means of scissors.

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[1] See Transactions of Medical and Physical Society of Calcutta, vol. ii.

The incision necessary for the exit of the lens being of considerable size, a semicircular flap of the cornea must be formed, extending to more than half its circumference. So far as regards the size and form of the incision, it may be made either downwards, upwards, or diagonally; but one or other of these directions may be the best, according to particular circumstances. The incision is formed at the distance of about $\frac{1}{20}$th of an inch from the margin of the cornea, and parallel to it. The operation consists of four periods or stages. First, the introduction of the knife through the cornea; second, the completion of the incision; third, the opening of the capsule of the lens; and, fourth, the displacement and removal of the lens from the eye.

As in the operations already described, some operators, being ambidexter, use the left hand in operating on the right eye, while others operate with the right hand on both eyes. In either case the incision of the cornea may be made downwards, upwards, or diagonally; the only difference required being that of the direction given to the cutting edge of the knife.

The cornea knife is to be held like a writing pen, while the first and second fingers of the other hand are employed in keeping one of the eyelids from closing[1]; an assistant being employed to take charge of the other eyelid, and retaining it open by pressing it against the margin of the orbit. The assistant is to avoid making any pressure on the eyeballs, but the operator is to place his middle finger upon the lacrymal caruncle and inner side of the eyeball, by which he will make such pressure as will be necessary for keeping the eyeball steady, and preventing it from rolling inwards towards the nose. The operator must also regulate the pressure on the eyeball according to circumstances, and the different stages of the operation.

In farther describing the different parts of this operation, we shall suppose, that the left is the eye to be operated upon, and that the incision is to be made downwards, through the lower part of the cornea.

The patient having been properly prepared for the operation in the manner formerly mentioned, may either be seated, or placed in a reclining posture. Regarding the artificial dilatation of the pupil, previous to the operation of extraction, there has been a diversity of opinion among surgeons; little advantage being derived from it, on account of the act of incising the cornea causing the pupil to contract. Some operators, indeed, consider the dilatation of the pupil positively hurtful, by tending to produce prolapsus of the iris after the operation.

The patient being properly placed, his head, eyelids, and eyeball being held steady by an assistant and the operator in the manner already described, he may draw the back of the knife across the cornea, in order that the patient may not start on the actual application of the instrument to puncture the eye: the eye is generally steady after this preliminary application of the knife. When it is not so applied the patient frequently starts, and the eye moves at the moment the surgeon applies the point of the knife to the cornea.

First stage or period.—This consists in penetrating the cornea with the knife, pushing it across the eye, and puncturing the opposite side of the cornea, where the point makes its exit, as represented in fig. 23.

The part of the cornea at which the knife is to be entered, is at the temporal side of the eye, a little above its transverse diameter, and at the distance of about the twentieth part of an inch from the margin of the cornea, the edge of the knife being directed towards the lower part of the cornea[1]. The point of the knife being directed towards the centre of the vitreous humour is now to be introduced so as to penetrate through the substance of the cornea; this direction of the knife being necessary to prevent the point passing between its layers. Whenever the point of the knife has fairly entered into the anterior chamber its direction is to be altered: it is now to be directed horizontally across the eye, parallel to the surface of the iris. The knife is then to be pushed quickly forwards, without delay or hesitation, till its point reaches the opposite side of the cornea, at a point on the nasal side, corresponding to that on the temporal side, at which the knife was made to enter, being at the distance of a line from the margin. By continuing the motion of the knife forwards, it is made to penetrate through the nasal side of the cornea from within outwards. This is called, the counter-punctuation of the cornea.

In completing this first stage or counter-punctuation of the cornea the knife cannot be carried too swiftly across the eye, in order that the aqueous humour may not be prematurely evacuated. Gentle pressure may be made to keep the eyeball steady, and the operator should not suspend the motion of the knife forwards, till the point of it has projected from about one eighth to a quarter of an inch beyond the counter-puncture of the cornea. This is the situation of the knife represented in fig. 23. All pressure is now to be removed from the eyeball, and the operator may pause in the movement of the knife. Pressure on the eyeball is now unnecessary, as the operator, having the eye transfixed by the knife, can keep it steady, and command its movements. Any pressure upon the eye, too, would now be highly dangerous, and might frustrate the successful accomplishment of the operation, by causing the evacuation of the aqueous humour, or pressing the iris under the edge of the knife.

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[1] Some operators, by practice, are able to keep both eyelids open without the aid of an assistant.

[1] It is an advantage to rub a little almond oil over the point of the knife, as this makes it cut more smoothly, and with greater facility. The point and edge of the knife should be proved by passing it through a piece of very thin leather; if it does not pass quite readily through, and without any grating sound, it is unfit for the purpose.

Second stage or period.—The cornea being now transfixed by the knife, and all pressure removed from the eyeball, the second period or completion of the incision of the cornea is now to be effected. This is best accomplished by simply pushing the knife forwards, by which it completes the incision by cutting itself out, dividing the lower part of the cornea upon which the edge was directed. In thus completing the incision, the knife must be moved very slowly and steadily, and while the previous stage of the operation could not be accomplished too quickly, this cannot be performed too slowly. No sawing motion should be given to the knife, and while it is moved steadily forwards, in the direction of its point, the whole of the knife should be pulled a little forwards towards the operator, which keeps the eyeball steady, and prevents its rolling in towards the nose.

The whole line of the incision thus formed, should be at the distance of $\frac{1}{20}$th of an inch from the margin of the cornea; for when it is made nearer than this, a portion of the iris is apt to be so much deprived of its support that it falls out and prolapses through the wound. Mr. Wardrop some years ago recommended the edge of the knife to be turned forwards, by which the incision was completed about half way between the transverse diameter of the cornea and its lower margin. Mr. Travers recommended that the lower part of the incision should be made half way between the pupil and margin of the cornea.

Immediately upon the exit of the knife from the eye, or rather at the very last portion of the incision, the assistant ought to let fall the upper eyelid; the operator then allows the eyelids to be gently closed, and the patient is directed to retain them so, and allow the eye to rest for a little. When the incision of the cornea has thus been completed, the aqueous humour escapes, and a partial collapse of the eye takes place, by which the iris and lens are pressed forwards in contact with the cornea.

This completes the most difficult and dangerous part of the operation, as during the accomplishment of it the most dangerous accidents are apt to happen. Fig. 24 represents the state of the eye when the incision has been completed.

From the difficulty of accomplishing properly this stage of the operation, and the great dexterity it requires, different other modes of forming the section of the cornea have been adopted.

Daviel, and some followers of his, first simply punctured the cornea with the point of a lancet-shaped knife, and then enlarged the opening to a sufficient extent by means of scissors. Others, after making a similar puncture, have completed the semi-circular section by means of a small round-pointed knife (fig. 20). A third mode which has been practised has been to transfix the cornea with a knife in the manner above-described, then to withdraw it just before completing the incision, leaving a small portion at the lower part of the cornea to be divided, so as to complete the section by means of scissors. And a fourth method which has been employed is that by introducing a knife, consisting of two blades, which, after being introduced through the counter-puncture, one of the blades is employed to keep the eyeball steady, while the other is pushed forwards so as to complete the incision of the cornea.

That the operation may be performed equally successfully by any of these methods cannot be questioned; but they are in general only a clumsy substitute for manual dexterity. They are modes of operating, however, which ought to be kept in view, as an operator, whatever his dexterity is, may be obliged to resort to one or other of them to complete an operation from the occurrence of some unexpected accident.

A properly-made section of the cornea is a very essential part of the operation of extraction, and depends much on the manner in which the knife is held. In the first place, the handle of the knife should be rather broad and flat, and by no means approaching to an equal-sided octagon. The handle in fact should be incapable of rolling betwixt the fingers. The young surgeon will find it advantageous to hold it between the points of the fore and middle fingers on the one hand, and the point of the thumb on the other, and in a direction somewhat at right-angles to them. By holding the knife in this manner, all the manœuvres can be much more readily executed by means of the fingers alone; but the great advantage consists in this, that the surfaces of the blade can be kept unerringly parallel to the surface of the iris and the base of the cornea, during its passage across the anterior chamber. This being the case, the edge of the knife has no tendency to cut out abruptly, or on the contrary be inclined towards the sclerotica.

According to the direction in which the edge of the knife is inclined when it pierces the cornea, and is passing across the anterior chamber, so must that of the section be. If the knife is properly held and entered, all that the surgeon has to do in carrying it across the anterior chamber, is to watch its point, so that the counter-punctuation may be made at the proper place; this being effected, the surgeon has complete command over the eye, and all that is now required is to push the knife steadily on, and it inevitably goes right. But if it has been ill entered at first, though the deviation of its surfaces from parallelism with the surface of the iris and base of the cornea may have been very slight, the deviation of the edge from the right direction rapidly increases with the progressive motion of the knife, and then the attempts to redress the knife cause the opening in the cornea already made to gape, and thus allow the aqueous humour to escape, and the iris to fall against the edge of the knife ; and besides all this, undue and irregular pressure is exerted on the contents of the eye, so that the completion of the section of the cornea is perhaps followed by the bursting forth of a quantity of vitreous humour with or without the lens. To illustrate the increasing deviation of the edge of the knife when improperly entered, we would mention a circumstance which every one must know. In cutting a slice of bread, if the knife be broad, and the edge not properly directed at first, the knife either cuts out before making a complete slice, or it sinks deep in the loaf; and if allowed to go on, would cut a slice of very unequal thickness.

Third stage or period.—The eye having been allowed to rest for about a minute or two, is now to be gently opened by the operator, and a small pointed hook or needle, called a curette (see fig. 19, *a*), is to be carefully introduced through the incision of the cornea by raising the flap. The convex part of this instrument is to be directed foremost. After it has passed through the pupil its point is to be directed to the anterior part of the capsule of the lens, and this part is to be lacerated by cutting it with the point of the needle in different directions. The needle or curette is then to be withdrawn in the same manner in which it was made to enter the eye, and all injury to the iris is to be carefully avoided. This being accomplished the patient is to be requested again to close his eyelids gently, and rest for a little.

In the accomplishment of this stage of the operation no pressure must be made on the eyeball.

Fourth stage or period.—This stage of the operation consists in the removal of the cataract from the eye. To accomplish this last stage of the operation, the operator raises gently the upper lid with the point of his middle finger, and depresses the lower lid with the forefinger of his left hand, by then making gentle pressure upon the eyeball by means of a curette or scoop (fig. 19, *b*) placed on the sclerotica at a small distance from the middle of the incision, the lens becomes displaced. Its lower edge rises up, and is tilted forwards into the pupil; by gently continuing the pressure the pupillary opening is expanded by the lens, and its exit through the pupil will be successfully accomplished. (See figs. 25, 26.) As the lens advances through the pupil it pushes forwards the flap of the cornea formed by the incision, as in fig. 26, and thus makes its exit from the eye. In some cases the marginal part of the lens is of softer consistence than the rest, and parts of it are broken off in its passage through the pupil. These, however, though they be left in the eye, are soon removed by absorption, and do not impede the success of the operation.

Should the lens appear to be arrested in its progress outwards, between the lips of the incision, its exit may be assisted by the point of the curette, small hook, or barbed needle. If the lens appears to be falling to pieces, the removal of them from the eye is rather to be assisted by the curette or scoop, than by pressure upon the eyeball, which may force out a portion of the vitreous humour. After the removal of the lens from the eye, the divided portions of its anterior capsule contract by their elasticity towards the circumference, and thus leave the centre of the pupil free and open. The operation being now completed, it is desirable that the eyelids be gently closed as during sleep, without being forcibly pressed together : but, in order to satisfy the anxiety of the patient as to the restoration of his sight, it is necessary to turn his back to the light, to open his eye gently, and then desire him to look at some large object. This experiment had better be dispensed with ; it has but one advantage, namely, that having been once made, it may prevent him afterwards from making trials by himself which might prove hurtful.

Before proceeding to speak of the after-treatment we shall detail the modifications of extraction which may be required on account of particular states either of the cataract or of the eye. We shall then mention the chief accidents which are liable to happen in performing this operation, and the manner in which they may be averted or obviated.

The operation for extraction, which has been described, is the mode of performing it on the left eye, making the incision of the cornea downwards. But when the right eye is operated on, the incision is in general made upwards, when the operator uses his right hand. Some operators, however, prefer making the incision or flap upwards in all cases, more particularly when the eyeball is very prominent, to prevent the closing of the lower eyelid from raising the flap and preventing its union by the first intention. Other operators prefer making the incision diagonally across the eye by introducing the knife at the upper and temporal part of the cornea, and bringing it through at the lower part of the nasal side when the left eye is operated on, or *vice versâ*, if upon the right. In making the flap of the cornea upwards upon the left eye, the operator directs the edge of the knife upwards, and introduces its point through the cornea somewhat below, rather than above its transverse diameter. In cases of cataract where the cornea is remarkably flat, and the iris projects forward in a convex form towards the cornea, so as very much to lessen the size of the anterior chamber, the case is certainly one very unfavourable for extraction. Yet this operation might be accomplished by dividing only one-third of the cornea with the knife, without attempting to carry it across the eye, and then enlarging the opening by means of scissors. But cases of this description should be considered unsuitable for extraction.

In cases of floating cataract, where there is in general a dissolved vitreous humour, and also in cases of capsular cataract, the same remarks as those just made are applicable. By a small incision of the cornea, and a hook, the cataract might be extracted, but its removal with the needle would be more proper and safe.

In cases of capsulo-lenticular cataract, the removal of the capsule being required as well as of the lens, this should be attempted in accomplishing the extraction. It may be done either before or after the removal of the lens. After dividing the cornea, a pointed curette may be introduced, and the capsule divided by it, in a circular direction, as near to the circumference of the pupil as can be accomplished without injuring the iris. This circular portion will sometimes be extracted upon the point of the instrument, or may be extracted by small forceps,—after which the lens is to be pressed out in the usual way. When the opaque capsule is to be removed subsequently to the lens, it may be effected by means of small forceps pulling it away in detached portions; or it may be left to contract and be removed at a subsequent period by means of a needle introduced into the eye, if it occupies the axis of vision. When the posterior part of the capsule is opaque, its removal should be accomplished by a subsequent operation by the needle.

§ 16. Accidents from the Operation of Extraction.

The operation for the extraction through an incision of the cornea is one of the most perfect and beautiful operations in surgery; and when successfully accomplished is followed by the most satisfactory results. But it cannot be denied, that it is also one of the most delicate and difficult, and that it is attended with several dangers from accidents which may happen in its accomplishment even in the hands of the most dexterous and experienced operators. These, we shall now enumerate.

a. *The Premature Evacuation of the Aqueous Humour.*

When this takes place before the knife has effected the counter-punctuation of the cornea, the eyeball becomes somewhat flaccid, and the iris is pressed forwards, and a portion of it gets under the edge of the knife. When the iris thus gets entangled with the edge of the knife, a portion will be divided, if the operator continues the incision without pressing back the iris by applying the point of his forefinger to the cornea. If the iris can thus be made to retire, the knife may be carried quickly across the anterior chamber so as to transfix the eye without the iris being injured. When this has been accomplished, there is no danger of the iris being wounded. If the iris cannot be made to recede, so as to be disengaged from the edge of the knife, several different modes of proceeding have been recommended. The knife may be withdrawn from the eye, and the operation deferred till some future day; or, the puncture of the cornea may be enlarged to a sufficient size by means of small scissors; or, a blunt-pointed knife may be introduced, by which the incision may be enlarged. But it is, perhaps, upon the whole, preferable to continue the incision as first intended, and rather cut off a portion of the iris than follow out any of these other methods: for, by none of them can the operation be so well accomplished as we could desire, and by that recommended, the eyeball will suffer less from manipulation; and the only inconvenience which arises from it is a slight enlargement of the pupil,—a circumstance which can do but little harm where there is some danger of the natural pupil becoming contracted. The enlargement of the pupil so made does not injure the sight or give rise to any unfavourable symptoms.

The premature escape of the aqueous humour takes place from tardiness in passing the knife across the eye, together with too much pressure upon the eyeball. It is a circumstance, therefore, which by care and attention may be avoided. Indeed, it may almost be said that the successful performance of this operation depends chiefly on every precaution being taken to avoid this accident, and being successful in preventing it from it happening.

b. *Difficulty in effecting the Counter-puncture of the Cornea.*

When the operator, as occasionally happens, finds that he cannot accomplish the projection of the point of the knife through the opposite side of the cornea, he may derive assistance from pressing his finger-nail upon the cornea. If the point of the knife bends to one side, or its point is broken off, he may find it impossible to accomplish the counter-punctuation in the ordinary way. Under such circumstances this part of the cornea may be punctured with the point of another knife, and then that which is already across the anterior chamber may be pushed through the puncture, and the section completed as at first intended.

c. *Incision of Cornea too small.*

When the section of the cornea is less than a semicircle, its size requires to be increased to prevent the occurrence of serious injury to the vitreous humour, iris, and other parts of the eye, from attempting to force out a cataract through an inadequate opening. The incision may be enlarged either by means of scissors or a small blunt-pointed bistoury for the purpose.

d. *The non-exit of the Cataract.*

After the operation has been so far accomplished, that the operator proceeds to what has been described as the fourth period of the operation, it occasionally happens that the lens does not start from its situation on the application of pressure to the eyeball. This may arise from various causes. First, it may arise from the incision of the cornea being too small; second, from the capsule of the lens being imperfectly opened; third, from unnatural adhesion between the lens and its capsule; and fourth, sometimes perhaps from the pupillary aperture not readily dilating. If the operator has reason to conceive that it is owing to either of the two first of these causes, they must be obviated by enlarging the apertures. A moderate and steady pressure is then to be applied; but if after this the lens does not make its exit from the eye, though its lower edge projects through the pupil, or a portion of the vitreous humour precedes it, an unnatural adhesion between the lens and its capsule may then be inferred. But as it would now be unsafe to continue the pressure upon the eyeball, from the risk of evacuating the vitreous humour, a small curved spatula should be introduced through the pupil to detach the lens and its capsule from the hyaloid membrane of the vitreous humour, after which it may be hooked out from the eye. In this manipulation some of the vitreous humour may be discharged, but there will be less risk of losing the eye than if the pressure had been continued.

e. *Fragments breaking from the Lens.*

It not unfrequently happens that in pressing out the lens, portions of its circumference become detached, and remain behind the pupil. When this is the case, subsequent pressure should not be applied to the eye to remove them, on account of the risk of pressing out the vitreous humour; but the eye should be gently rubbed, through the medium of the upper eyelid, after which the fragments will be found to have advanced into the anterior chamber; if so, they will readily be removed by raising the flap of the cornea with the curette. Should any particles of the lens remain, they will soon become absorbed, so that it is both unnecessary and very likely to be injurious, to make any further endeavours to remove them.

f. *Escape of the Vitreous Humour.*

The escape of a portion, or the whole of the vitreous humour, is often attributed to spasmodic or violent action of the muscles of the eyeball, but is more commonly to be attributed to immoderate pressure upon the eye, or to weakness and disorganization of the hyaloid membrane from age or disease, or its having been lacerated at some stage of the operation. The escape of a portion of the vitreous humour does not frustrate the success of the operation, and has even been considered, in some cases, an advantageous occurrence, by lessening the tension of the eye when inflammation takes place. Protrusion of the vitreous humour may occur either before the exit of the lens, along with it, or after it. If a portion of the vitreous humour either projects from the pupil, or escapes before the lens, no farther pressure should be made upon the eye, and the cataract should be removed by means of a hook, or barbed needle, introduced through the pupil. There is a difference of opinion as to how much of the vitreous humour may be evacuated without vision being destroyed. If less than a third escapes, the recovery of the eye, and the restoration of sight, may not be much impeded; but when this accident has happened, and a portion of the hyaloid membrane is protruded between the lips of the incision of the cornea, the healing of the wound goes on slowly and unfavourably, and the pupil is distorted by the iris being pulled towards the incision. A protrusion of the iris is also very apt to take place from the wound; and if more of the vitreous humour than a third has been evacuated, the prognosis is very unfavourable, from the probability of permanent collapse of the eye and closure of the pupil.

When a portion of vitreous humour projects from the wound of the cornea, and cannot be replaced, it should be snipped off with the scissors, by which the remainder is allowed to fall back into the eye, and withdraw the portion of hyaloid membrane which was interposed between the lips of the wound.

It is particularly worthy of remark, that in operating on glaucomatous eyes, or on those where an operation for the removal of a cataract had been previously attempted by the needle, and by which the capsule of the lens and hyaloid membrane had been lacerated, a disorganized state of the vitreous humour may be expected.

g. *Protrusion of the Iris.*

After the lens has been extracted from the eye, a portion of the iris is apt to protrude through the wound in the cornea. When this does not happen from the incision being too close to the margin of the cornea, it may in general be remedied by gently rubbing the eyeball through the upper eyelid, and then suddenly exposing the eye to the light. If this does not succeed, the iris may be pressed into its place by the point of the curette; or, when the iris projects or bulges in the form of a bag, by making an opening into it by the snip of scissors, so as to evacuate the aqueous humour from behind it, the return of the protruding portion will take place.

But if a protrusion of the iris takes place some days after the operation, and in a gradual manner, attended with the gaping, swelling, and opacity of the edges of the wound, no direct attempt need be made to replace the iris. In this case it is probably the result of inflammation, so that antiphlogistic remedies should be vigorously applied; and if the protrusion is large, the aqueous humour contained in it may be evacuated. These means are most likely to accomplish the replacement of the iris, and to prevent further injury to the eye. The use of belladonna should, in such cases, be avoided, as it might increase the protrusion. In some cases of this kind the inflammation of the eye is severe, and of long duration, and recovers with a contracted pupil drawn towards the wound. In some of these an operation for artificial pupil may afterwards restore sight when it has been so lost.

The application of belladonna to the eye, either shortly before or after the extraction of cataract, has been found to increase the liability to protrusion of the iris so much, that it is now seldom used before the operation, and never after it, till the wound of the cornea has united.

h. *Inflammation of the Eyeball.*

Inflammation of the eye always follows the operation of extraction to a greater or less extent, the organ having suffered a considerable wound. A certain degree of inflammation is absolutely necessary for the healing of the incision. To prevent the inflammation being greater than is necessary for this purpose, always demands the assiduous attention of the surgeon. The inflammation which follows, occurs in different degrees in almost every case ; it affects different parts of the eye, nor is it uniform in the period of its attack. When the internal parts are affected, such as the iris and choroid coat, to a considerable degree, the eye is in great danger of being destroyed. The inflammation is indicated by pain in the eyeball or forehead, redness and tumefaction of the eyelids, a feeling of sand, and sometimes pulsation or throbbing in the organ, external redness of the eyeball, opacity of the cornea, effusion of lymph or pus into the aqueous humour. These are sometimes attended with quickness of pulse, headach, and other symptoms of fever.

The inflammation which supervenes, in the generality of cases, after the operation of extraction, has led operators to adopt the practice of bleeding their patients from the arm, shortly after the operation, as a means of prevention. It is probable, however, that inflammation may be best prevented by the patient adhering to an antiphlogistic regimen for some time previously to the operation, as well as after it, as has already been illustrated by the cases alluded to at § 9.

When there is much disposition to inflammation in the system, which may in general be known by the previous history and state of the patient, it is better not to perform extraction, but to have recourse to some of the other operations by the needle. Before operating, however, it is necessary that the patient, under such circumstances, should live upon a very spare diet, which may obviate the tendency to inflammation.

§ 17. Modifications of the Operation of Extraction.

Operations for the extraction of cataracts through the cornea, have been performed in several ways, but in each by a smaller opening in the cornea than that made in the common mode already described.

I. The *first* of these modifications which requires to be noticed, is that of the extraction of the lens when situated in the anterior chamber of the aqueous humour in the manner the operation was first performed by Daviel. This consists in making an opening through the cornea, to the extent of one-third of its circumference, with a lancet-shaped knife ; a small hook is then to be introduced, by which the lens is to be laid hold of and extracted. This mode of removing the lens, when situated in the anterior chamber, from accident, as by a blow upon the eye (or during an operation with the needle for the displacement of the lens), has led some operators[1] to place the lens first in the anterior chamber by the needle, introduced through the sclerotica, and then to extract it by the less extensive opening in the cornea above mentioned. To this operation a preference has been given, because it is more easily accomplished, the less extensive wound of the cornea heals more readily, and the lips of the wound, by being more completely approximated, obviate the risk of prolapsus of the vitreous humour, or of the iris. When the vitreous humour is in a dissolved state, this mode of operating will be less dangerous to the eye than the common operation for extraction, from its being completed without pressure upon the eye, which might cause the evacuation of that humour.

In performing this modification of extraction, the needle, which is introduced through the coats of the eye, to push the cataract into the anterior chamber, requires to be held by an assistant, to retain the cataract in its new situation, while the operator makes the incision through the cornea and extracts it.

2. Another modification of extraction is that first practised by the late Mr. Gibson of Manchester, for the removal of soft cataracts[2]. The mode which this gentleman practised was to rupture freely the anterior part of the capsule of the lens with a needle, and after an interval of two or three weeks he extracted the pulpy lens, through a puncture at the side of the cornea. After making the opening through the cornea, the point of the needle was made again to lacerate freely the capsule of the lens. After this the portions of the lens were evacuated with the assistance of the curette introduced through the cornea and pupil.

This operation Mr. Gibson was led to adopt in order to supersede the repeated operations which were in general necessary for the removal of cataracts by solution, a measure which obviated the inconvenience to the patient of being harassed with numerous operations, and his health injured by a tedious cure.

3. *Extraction of cataracts through the sclerotica.*—Several surgeons have at different times recommended the extraction of cataract through

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[1] Travers, Med. Chir. Trans. vol. v.

[2] Practical Observations on the Formation of an Artificial Pupil; to which are annexed Remarks on the Extraction of Soft Cataracts, &c. p. 103. London. 1811.

an opening made in the sclerotic coat. Some of these[1] have recommended the opening to be made parallel to the margin of the cornea; others[2], in a direction perpendicular to it. The opening is to be made at the upper part of the eye with a lancet-shaped knife. After this opening has been made, the cataract is to be laid hold of with a hook or forceps, and extracted without making any pressure on the eyeball.

The late Sir James Earle invented an instrument for the purpose, consisting of "a small spear-pointed lancet, of a proper breadth, which introduces a pair of fine forceps into the globe of the eye, and when sufficiently inserted, the sharp or spear point, by means of a spring, is withdrawn, leaving the forceps behind; with these the cataract may be gently seized, made to quit its connexions, and be brought away through the opening: and thus is completed the whole operation." Sir James used the instrument for extracting an opaque lens or capsule, and he tells us that, "capable of acting in a double capacity, the instrument becomes the best of all possible couching needles[3]."

This mode of performing the extraction of cataracts has never been generally practised, and we are not aware that it has been attended with a sufficient degree of success to recommend its adoption.

§ 18. Treatment of the Patient after Operations for Cataract.

The great danger to be apprehended from the supervention of inflammation, after operations for cataract (which constitutes the chief cause of their failure), renders it always a matter of solicitude on the part of the surgeon to employ every means in order to prevent inflammation from ensuing. Hence the antiphlogistic regimen requires to be strictly enforced.

When the operation for cataract has been completed, the patient should move himself as little as possible in being conveyed to bed. The room should be well aired, of a comfortable temperature, but not too warm; and the light admitted into it should be lessened, but not altogether excluded. The patient ought to be cautioned to make as little muscular exertion as possible, and to keep his eyes closed as in sleep, without forcibly compressing them. He should lie for the most part on his back, with his head and shoulders well raised.

The eye operated on is to be kept cool with an evaporating lotion, consisting of a solution of acetate of lead. For this purpose two or three folds of linen are applied over the eye, and kept constantly wet with this lotion. If the patient is full and stout, blood, to the extent of iii lbs. should be taken from his arm immediately upon the occurrence of pain in the eye. In fact, the case requires to be treated as that of a wound of the eyeball. And inasmuch as the wound in the operation of extraction is much greater than that in any of the other operations, the inflammation is generally greater, and requires more prompt and vigorous measures both to prevent and to subdue it. After extraction, the patient is therefore generally bled from the arm a few hours after the operation, as a preventive of inflammation.

In some cases repeated general and local bleedings, warm fomentations and blisters are required, according to the degree of inflammation, as indicated by the appearance of the eye, the degree of pain, and increased frequency and strength of pulse. The exhibition of purgatives, and after these, antimonial, nauseating, and diaphoretic medicines, and warm bathing of the feet, are often useful auxiliaries.

After operations with the needle the eye may be examined by opening it on the day after the operation, and every day subsequently; but after extraction, it has been found best not to open the eye for three or four days. The eye may then be looked at. If the case has gone on well, the incision of the cornea will be healed. In eight or ten days the patient may be allowed to rise from his bed, after which he will gradually recover.

Inflammation of the eye is sometimes protracted, after extraction, by the protrusion of a portion of the hyaloid membrane of the vitreous humour, or of the iris, from the wound of the cornea. Each of these may require the application of scissors and nitrate of silver for their removal.

When there is a disposition to rheumatic or gouty inflammation in the system, the inflammation following operations upon the eye, often assumes the same character. The case then requires to be treated on general principles. When violent inflammation of the iris takes place, the exhibition of mercury, and the application of belladonna, in addition to the other remedies, are generally highly beneficial.

§ 19. Choice of an Operation for the Removal of Cataract.

Each of the different modes of operating which have been described, has the same object in view,—the removal of the cataract. These operations, however, are not equally suited to each kind of cataract; thus, the operation by absorption is the best for the removal of fluid or soft cataract, and depression or extraction are inadmissible; while that by extraction, when successfully performed, is the best for the removal of hard cataracts. Yet these operations have each had their advocates and opponents, who have canvassed their merits in order to show the superiority of one over another, as if each of them was equally applicable to all cases. Of late years, however, it has been pretty generally admitted that cataracts can be properly treated only by the selection of that operation which is best suited to the nature of the individual case under consideration. A few of the opinions of the most eminent surgeons upon this subject may be here quoted.

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[1] B. Bell.

[2] Earle. Mackenzie.

[3] An Account of a new mode of operation for the Removal of the Opacity in the eye called Cataract, by Sir James Earle, F.R.S. London, 1810. Mr. Middlemore, of Birmingham, has recently invented a similar instrument, which he calls a "needle-forceps."

Mr. Lawrence in his work on Diseases of the Eye makes the following remarks: "No person who understands the subject would advise any one operation to be employed exclusively. Each method has its advantages, and is eligible under certain circumstances; our object then should be, not to select one operation with the view of practising it in all cases, but to consider the circumstances which give a preference to one or the other, and to select in each instance, that which is best suited to the particular form of the complaint[1]." Mr. Guthrie says, "It has been proved, that dexterity in operation, and precision in the performance of it, will enable a surgeon to do more in every operation than can be done by another who does not possess these qualities in an equal degree; but it has been no less proved, that certain states of disease are better adapted for one operation than another, and that each variety of cataract is not favourable for the operation of extraction, displacement, or division. The greatest attention has been, and is paid, to this subject by every man of judgment and honour; and supposing an equal degree of dexterity in the performance of all, the choice of the operation depends, 1st, upon the nature of the disease, and 2dly, upon the state of the parts implicated by the operation[2]."

Dr. Mackenzie of Glasgow, after describing the different operations for cataract, and the cases to which they are most applicable, remarks as follows: "The conclusions to be drawn from a general review of the operations for cataract are, that each possesses advantages and disadvantages, and is attended by peculiar dangers; that one mode of operating will be suitable for one case of cataract, and another for another, and that there can be no more incontestable proof of a man's ignorance of this subject than his asking which of these operations we practise, or of a man's being a charlatan, than his pretending to cure all kinds of cataract by one kind of operation alone, modified by some trifling change in the manipulations or the instruments. Each of the operations for cataract will, in certain circumstances, recommend itself to our choice; none is to be universally adopted and practised to the entire rejection of the other[3]."

Mr. Travers, also, though he gives a decided preference to the operation of extraction, in cases of cataract of firm consistence, entertains precisely similar opinions to those above quoted[4].

§ 20. Advantages and Objections to the different Operations for Cataract, and the Cases to which they are best adapted.

1. *Regarding the operation of absorption.*—In pointing out the cases to which the different operations for cataract are best adapted, they may be arranged under four divisions:—1, soft and fluid cataracts; 2, firm and hard cataracts; 3, capsular cataracts; 4, cataracts complicated with other morbid states of the eye. These are the divisions which will be chiefly kept in view, in the following remarks upon this subject.

As to the great merit, the superior safety and complete success of the operation by absorption, in cases of soft cataract, and particularly those of young subjects, whether congenital or arising from injury, there is no difference of opinion among professional men. To the skill and experience of the late Mr. Saunders[1] we are much indebted for accurate information upon this subject; and his observations have been amply confirmed by the experience of subsequent operators. "It is impossible," says Mr. Travers, "to conceive a more simple, sufficient, or gratifying operation than that of Mr. Saunders, if the intention is perfectly executed. I have now enjoyed extensive opportunities of ascertaining its value, having operated during a period of ten years upon children of all ages, from four months upwards, and I do not hesitate to affirm that it ranks in my estimation as one of the finest discoveries of modern science[2]."

The advantages of this mode of operating, which decidedly render it preferable in the cases above alluded to, have been very generally admitted. Accordingly, the few objections that have been urged against it are rather to be considered as inconveniences than circumstances which either preclude the adoption of this operation, or give a preference to any of the others. These inconveniences are, 1st, that the torn capsule may reunite and prevent the action of the aqueous humour upon the cataract. This renders one or more repetitions of the operation necessary, the division of the lens, and the removal of its fragments into the anterior chamber. 2dly. Opacity of the capsule not unfrequently takes place after this operation; but this is an inconvenience which is as liable to follow either of the other operations. The same remark may be made regarding inflammation; but, as in this operation, less injury is done to the interior of the eye than in any of the others, less inflammation is to be expected, and, indeed, very rarely takes place to a dangerous degree.

2. *Couching, or Displacement.*

Couching, or displacement, was for a long period the only operation performed for the cure of cataract. But, since the introduction of the operation of extraction, the advantages and disadvantages of each of these modes have been ably and keenly canvassed, and each has been maintained to have a preference over the other, by that system of exclusive tactics which holds out the many advantages of the one as opposed to a long enumeration of the disadvantages of the other. Many of the arguments, it must be admitted, which have been urged on both sides, are well founded, and deserving of due consideration; but others are certainly founded on objections, or disadvantages, which are to be attributed rather to the operator than to the operation.

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[1] Lawrence on Diseases of the Eye, p. 417.

[2] Guthrie's Lectures on the Operative Surgery of the Eye, p. 366.

[3] Mackenzie on the Eye, p. 670.

[4] Travers' Synopsis of Diseases of the Eye.

[1] See Saunders on the Eye, edited by Dr. Farre.

[2] Travers' Synopsis, p. 321.

As the operations by displacement and extraction are applicable to almost the very same description of cases, viz. to cataracts occurring in elderly persons, of a firm consistence, the question may here be discussed which has frequently been agitated, as to which of these operations is the best.

Couching or displacement is applicable only to cataracts of a firm consistence; and it may be performed in some cases, in which extraction would either be imprudent or inadmissible. There are cases where the cornea and anterior chamber are small, where the cornea is opaque, or encroached upon by the arcus senilis, where the eyeball is much sunk in the orbit, and where the cataract is complicated with a constricted pupil or morbid state of the vitreous humour: also where the unsteadiness, or old age, or bad health of the patient make it objectionable or impracticable.

It has been urged in favour of the operation of couching or displacement of cataract, that little injury is done to the eye—that less inflammation in general supervenes from it than from extraction—and that the operation may easily and safely be repeated if unsuccessful. These are important and well founded arguments in favour of the displacement of the cataract.

The disadvantages which have been observed to follow the operations for displacement of cataract, are—first, the great liability of the lens to rise again into its former situation; second, the laceration of the vitreous humour into which it is embedded, which is liable to cause disorganizing inflammation of the eye; and, thirdly, it has been objected to the depression of the lens, that the iris, retina, and choroid coat are apt to be injured in accomplishing it, as well as by the contact of the lens affecting them afterwards; and hence the preference which some have given to reclination. The first and third of these objections, however, are by no means necessary accompaniments of the operation, and should not occur when it is properly performed. In the reclination of the lens, or horizontal displacement of it, the objection founded on the laceration of the vitreous humour is the same as in the vertical displacement; in which last the injury is, perhaps, less than in the former; and it is a necessary accompaniment of the operation which cannot be avoided. "The real objection," says Mr. Travers, "to couching is, the ultimate step of the operation, viz. the breaking up of the fine texture that fills the globe by the forcible depression of the lens. Whether it be depressed edgeways or breadthways makes no difference in the result; it must still occupy a breach in the cells of the vitreous humour, and must derange and disorder that delicate texture and those connected with it. A slow insidious inflammation, marked by a gradual development of the symptoms of disorganization, viz. congestion of vessels, turbid humours, flaccid tunics, and palsied iris, is too often the consequence. The sight, instead of improving when the immediate effects of the injury are passed away, remains habitually weak and dim, or declines and fades altogether[1]."

3. *Extraction.*

The extraction, or complete removal of the lens from the eye, is very generally admitted to be one of the most perfect operations in surgery. It is adapted chiefly to cases of hard or firm cataract, affecting persons advanced in life; but there are a greater number of circumstances which physically preclude the accomplishment of this operation, than that of displacement. Besides, other two objections have been urged to extraction, which will deserve attentive consideration; viz. the greater danger incurred to the eye from its adoption than in any other operation, and the much greater difficulty of performing it.

1. The circumstances which render the adoption of extraction improper or impracticable are, small anterior chamber, an eyeball much sunk in the orbit, an opaque state of cornea, adhesions between the iris and the cornea or capsule of the lens, a contracted pupil, a soft and boggy state of the eyeball, from disorganization of the vitreous humour, when the patient, being much advanced in life, or when he is of so very irritable and restless a temperament, that the eye cannot be properly steadied during the operation. In some cases, where any of the above circumstances exist, it would be very imprudent to make the attempt, and in others it would be impracticable to perform the operation of extraction with safety and success.

The existence of an arcus senilis upon the cornea is not of itself to be considered an obstacle to the operation of extraction.

2. The greater danger which has been alleged to arise from the operation of extraction compared with the operations by displacement with the needle, will be found to be owing more to the operator than to the nature of the operation, provided none of the circumstances above enumerated, as forbidding the operation, exist.

3. The difficulties and dangers of this ope-

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[1] Travers' Synopsis, pp. 318, 319. See also Mackenzie, p. 723.

ration, which have been commonly enumerated, will be found to have arisen chiefly, if not altogether, from incapacity or inattention on the part of the operator, or from unfavourable circumstances in the case which rendered the operation of extraction improper. "The operation of extraction," says Mr. Travers, "is by far the most perfect ever devised for the cure of cataract; but it is one of considerable difficulty, and the several modifications which have been at various times suggested, owe their origin to the disappointments and defeats which operators meet with in learning to execute it with success. The preference entertained for couching, rests on no better ground than its greater facility, and, therefore, less risk. No operation in surgery, I am well satisfied, requires an equal degree of temper and experience for its accurate and successful performance[1]." After combating the usual objections to extraction, he says, "They apply to the performance, not to the principle of the operation;" and at a subsequent place he adds, "When the operation is perfect, its pre-eminence is too conspicuous to admit of illustration; it exacts the homage of admiration beyond any effort of the art[2]."

"The operation of extraction," says Mr. Lawrence, "is particularly applicable to cases of firm cataract, especially in persons advancing in years; the cataract being hard, and less susceptible of absorption, is removed from the eye. The incision of the cornea may be healed in 24 or 48 hours after the operation, the object of which is then accomplished, though it would not be prudent to employ the eye at that time. Thus the advantages of the operation are, the complete removal of the cataract, and the speedy restoration of sight[3]. * * * * Undoubtedly, extraction is an operation of considerable nicety; and unless it has been frequently performed on the dead eye, the expectation of success on the living subject would be as absurd, as the attempt would be unjustifiable. The operation of depression on the other hand is easy, and requires no particular practice beforehand[4]."

"Extraction," says Mr. Liston, "in favourable circumstances, and in dexterous hands, is a beautiful operation, and most satisfactory; but ought not to be undertaken unless the surgeon has perfect confidence in himself[5]."

"That extraction," says Dr. Mackenzie, "is the only proper mode of removing a hard cataract, is an assertion, the truth of which those who have had any considerable experience in the treatment of eye diseases, and have been able to think for themselves on the subject, are as firmly convinced as they are that soft cataract may safely and satisfactorily be cured by division. To attempt the cure of hard cataract by division would be worse than useless. When no particular contra-indication, therefore, exists to extraction, we have recourse to that operation; and the only points remaining for our consideration are, the contra-indications to extraction, which may exist even when the cataract is hard, and the comparative advantages of a large or small section of the cornea[1]." "Reclination and depression," he adds, at page 723, "are to be thought of only when some insuperable objections exist to division and extraction."

The disadvantages of extraction are those arising from inflammation of the eye, but more particularly of the iris, or when a portion of it protrudes through the corneal section, giving rise to closure of the pupil, want of union in the opening of the cornea, or the ulceration of its edges, the escape of a portion of the vitreous humour, and atrophy of the eyeball.

When we consider, therefore, the perfect nature of the operation of extraction, and the little injury done to the eye when it is properly and dexterously performed, consisting merely of an incision of the cornea and capsule of the lens. When we compare it with the operation of displacement of the lens into the vitreous humour, in which of necessity the vitreous humour and other parts of the eye are lacerated, and the lens allowed to remain and act as a foreign body; and when we enumerate as the advocates of extraction the names of Wenzel, Beer, Ware, Phipps, Lawrence, Travers, Alexander, Guthrie, and Mackenzie; when we take into consideration also the grounds upon which the opinions of these men are founded, after extensive experience and mature deliberation, very little doubt can exist as to the preference which ought to be given to extraction over displacement.

That there is difficulty in performing the operation of extraction with dexterity and precision no one will deny who has attempted it, though a bystander upon witnessing this might scarcely believe it: this objection to the operation may be overcome by attention and experience. It is, therefore, an objection not belonging to the operation, but attaching to the operator.

The dangers, untoward accidents, and risk of destroying the eye, of which much has been said, and with great exaggeration, apply also to the operator, and not to the operation.

Concluding remarks.

In the remarks above made, the question has been discussed as to the comparative merits of extraction and displacement of the cataract; it is therefore hoped that the reader will be able to form a proper estimate of their relative merits. The truth of the assertion formerly made must now be farther obvious, that the proper treatment of cataract consists not in the adoption of any one operation, but in selecting that best adapted to the circumstances of each individual case; a point which can only be decided by a careful consideration of the nature of the cataract, the circumstances of the patient, and the principles above established from experience.

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[1] Travers' Synopsis, 322, 323. [2] Ibid, p. 332.

[3] Lawrence on the Eye, pp. 429, 430.

[4] Lawrence on the Eye, p. 430, 431.

[5] Liston's Elements of Surgery, vol. ii. p. 131.

[1] Mackenzie on the Eye, p. 721.

The qualifications necessary on the part of the surgeon for performing these operations, have been well summed up by Mr. Liston. "The operator," he says, "must have a good eye, a steady, light, and skilful hand, a fine touch, courage and caution; qualifications necessary in all surgical operations, and in none more so than in those on the eye[1]."

It is only further necessary to remark, before concluding this subject, that the absence of the crystalline lens from the axis of vision, has a material effect in altering the refraction of the rays of light. As the refracting power of the lens is entirely of a physical nature, simply concentrating the luminous rays which enter the eye, the defect from its absence can be made up or compensated by the use of a double convex lens worn externally. Hence individuals who have been successfully operated on for cataract, generally require to wear glasses of a considerable magnifying power. They in general require glasses of two degrees of strength; the one of lowest power, for viewing distant objects, which is generally a lens of six or seven inches focus, the other, and stronger of the two, for viewing near objects, as in reading or writing, requires to be about two and a half or three inches focus. Those individuals, however, who have been previously short-sighted, require no glasses, the previous defect in their sight being compensated by the absence of the lens.

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(Alexander Watson.)

EXPLANATION OF THE FIGURES.

Fig. 1. *a. The aqueous humour.—b. Ciliary ligament, root of iris, and anterior part of vitreous humour.—c. Lens.—d. Vitreous humour.*

Fig. 2. 1. *Form of lens at infancy.*—2. *Ditto at seven years.*—3. *Ditto of adult.*—4. *Ditto at old age.*

Fig. 3. *Spontaneous solid lenticular cataract from an elderly patient.*

Fig. 4. *Ditto, having a radiated appearance.*

Fig. 5. *Capsulo-lenticular cataract; the parts most opaque are where the capsule is opaque.*

Fig. 6. *Glaucoma resembling cataract from the opaque appearance of the humours of the eye.*

Fig. 7. *Lens rendered opaque by a blow on the eye, a few days previously, from a small branch of a tree. There was no wound of the eye; the lens must therefore have been displaced, and its capsule ruptured at the centre, where a portion of the substance of the lens is projecting.*

Fig. 8. *Exhibits the appearance of the eye, after the capsule and lens had been torn and cut in pieces, and pushed into the anterior chamber with a needle. The substance of the lens presented a flocculent appearance, but became dissolved by the aqueous humour in a few weeks.*

Fig. 9. *Adventitious cataract from lymph occupying the pupil.*

Fig. 10. *Lenticular cataract, in which the centre is more opaque than the rest, and has the form of a star.*

Fig. 11. *Capsular congenital cataract, where the lens had been spontaneously absorbed from a child.*

Fig. 12. *Shreds of capsule opaque, forming secondary capsular cataract, after an operation which broke up the lens, and made it dissolve, from a child.*

Fig. 13. *Shreds of opaque capsule on surface of vitreous humour, after operations for the removal of the opaque lens.*—Fig. 14. *The same; both from young men. In these two last figures, the pupils are represented as dilated with belladonna. Before the pupils were so dilated,* in fig. 13, *only two white lines were seen crossing the pupil;* in fig. 14, *none of the opaque parts were visible.*

Fig. 15. *Beer's cataract needle.*

Fig. 16. *Scarpa's ditto.*

Fig. 17. *Dr. Jacob's ditto.*

Fig. 18. *Curette and David's spoon on one handle.*

Fig. 19. *Blunt-pointed knife for enlarging the section of the cornea when made too small.*

Fig. 20. *Represents a cataract needle introduced into the eye.*

Fig. 21. *A diagram, showing the positions of the lens after displacement.*

Fig. 22. *Represents the act of making the section of the cornea for extraction of cataract.*

Fig. 23. *Represents, by a diagram, the state of the eye when the incision of the cornea has been completed.*

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[1] Elements of Surgery, vol. ii. p. 125.

By the evacuation of the aqueous humour the cornea has collapsed, and the vitreous humour, lens, and iris, have become pressed forwards upon the cornea. This figure may be compared with fig. 1, *which shows the parts in their natural situation. In figures* 23, 24, *and* 25, *the point at f is the place at which the cornea has been divided.*

Fig. 26. (*from Dr. W. Soemmering*) *The interior of the eye of a woman, seventy-three years of age, in which the lens, along with its capsule, was reclined by Dr. Emden. The cataract re-ascended, and three months after the first operation, the reclination was repeated. A segment of the cataract always continued visible behind the pupil, notwithstanding which the patient saw well for three years, when she died.*—Mackenzie, Op. Cit. p. 679.

Fig. 27. (*from Dr. W. Soemmering*) *Shows the interior of an eye dissected by Dr. Soemmering, eight years and a half after reclination. The lens had entirely disappeared, a portion of the centre of the capsule, which had been displaced along with the lens, appears curled up, and lying in the lower and outer part of the ciliary body, while the remainder of the capsule forms two transparent semilunar flaps, retaining their natural situation, the one behind the upper and the other behind the lower part of the iris.*—Mackenzie, Op. Cit. p. 674.

CATHETER, from καθιέναι, to thrust in, *algalie, sonde*, Fr. *Harnleiter*, Ger. Catheters are cylindrical tubes chiefly employed in evacuating the urine from, or injecting fluids into the bladder; they are also used in exploring the viscus to determine the presence of stone, and to dilate the urethra, being thus applicable either for the diagnosis or treatment of diseases of the urinary organs. French surgeons apply the name of catheter to the grooved staff employed in the operation of lithotomy, reserving the synonyms above mentioned for the instrument denominated catheter by us.

These instruments are generally made of gold, silver, platina, metallic alloy, or gum elastic (see Bougie); they are flexible or inflexible, and vary considerably in length, size, shape, and curvature, according to the age, sex, or particular case for which they are employed. The elastic gum catheter which has been rendered so perfect of late years is formed of silk thread closely woven on a brass wire or stilet, over which successive layers of siccative oil are laid till the silk tissue is entirely covered. The openings or eyes are formed in the tissue itself, and sometimes the instrument is made without any opening, or with one only[1]. They are smooth and highly polished, and are less irritating to the urethra, when they are to be worn for any time, than the metallic ones. At one extremity, the instrument is rounded or coned, at the other it is open to receive a stilet, which is used to give the desired curve, or to keep the interior clean. In the metallic instruments, this end is sometimes shaped into a flat handle, either of wood or metal; rings, too, are formed for the purpose of fixing the instrument in the urethra by means of cotton cord which is passed through those rings. There is a bandage in use for this object (see Bandage, Fig. 148); but the same end may be accomplished by tying the cord on the catheter close by the orifice of the urethra, and then carrying both ends of the cord to form two knots, one to bind the other on the dorsum of the penis just beyond the glans, and then tying the ends together in a third, or running knot under the urethra.

The inconveniences arising from the want of a standard size for catheters are much felt, and might be easily remedied if the manufacturers would adopt the plan of graduation proposed in the article Bougie, which is to take half a line for unity, and augment by half a line for each ascending number, till the size of four lines be attained. The catheter used for females is considerably shorter than that for males, and is but slightly curved. The observations connected with the curvature and shape of this instrument will form part of the succeeding article, which will contain also a description of a catheter proposed some years ago by the author, and which is now extensively employed, being, so to speak, a self-guiding instrument in passing down the urethra. (See also Urethra.)

CATHETERISM.—By the word "Catheterism" is understood the introduction into the urethra, and most commonly down to the bladder, of an instrument proportioned to the size and length of the canal, whatever be the object of such introduction and whichever the instrument employed, be it a solid or grooved staff, a silver inflexible, or a gum elastic flexible catheter, a wax or metallic bougie; be it straight or curved. Catheterism, or sounding, is also used to designate other processes of exploration performed on the different mucous outlets of the body, and even on fistulous or accidental apertures; thus we speak of the catheterism of the Eustachian tube, of the nasal canal, of the antrum, of Steno's duct, of the œsophagus, and of the sinuous course of wounds or fistulous openings. But when the term is used without further qualification it designates the exploration or sounding of the urinary passages.

However inconsistent the avowal may appear with our present purpose, it is nevertheless perfectly true, that dexterity and suavity in the introduction of instruments is less to be acquired by the precepts hitherto inculcated in books, than by practice and example, and even some of the rules laid down to guide us on this point do not deserve to be particularly extolled. The surgical doctrine of catheterism stands in great need of simplification, and the few rules that really are useful with relation to it require to be redeemed from that over refined elaborateness, the effect of which is too frequently to intimidate the young surgeon, thus insuring a clumsy and painful performance of this surgical ministration, from the mere dread of a barely possible mischief. To him who possesses the necessary anatomical and physiological knowledge, sounding the bladder when the urethra is healthy and unobstructed may soon be rendered a simple and easy operation. But the instructions derived from books alone will not suffice; they are, in too many instances, the offspring of superficial observation or vague theory, and too frequently when obstacles occur, a reference to those rules will afford no assistance whatsoever in overcoming them.

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[1] These openings are made near the rounded end of the catheter, but if the end itself were left open, we should have an instrument more advantageous under certain circumstances than any catheter with lateral eyes.

The great diversity of conformation in the parts concerned in catheterism, the variety of instruments employed for the purpose, with many other circumstances, seem to authorize the multiplication of rules to govern us in its performance. But the real truth is, the attempt to regulate and refine on all the incidents belonging to it, by obscuring the simple nature of the subject, has only tended to perplex and embarrass us in the consideration of it. Had the canal of the urethra been of equal diameter or purely cylindrical, and had it followed the same direction throughout its entire length, the operation of passing the catheter would be comparatively simple, and one general rule would embody all that could be said on the subject. But such is not the case. The points, therefore, that occur in its course where the cylindrical form does not exist, and those in which its direction is altered, are those which it is important to study, with a view to the easy, painless, and safe mode of introducing the catheter.

Under the head Urethra, these points will be dwelt on particularly, with a view to form a basis for our observations on the introduction of the catheter. We shall have to remark, that all the depressions of the urethra are to be found on its inferior surface; and that all its naturally narrow points are nearly circular, and comprise the entire circumference of the tube. The greatest depth of those depressions does not correspond to the middle of their length, but will be found nearest to their vesical extremities, and thus when the bec of a sound dips into them it must go on to near the farther end before it reaches the deepest point; the ascent is then sudden, and if the bec is not made to clear it by ascending with the same abruptness, it becomes capped with the membrane, and its progress is arrested. This is the first kind of obstacle, that opposes the progress of an instrument along the urethra.

The second kind of obstacle arises from the instrument not moving in the axis of the canal; let us take an example: the entrance of the muscular part of the urethra is, with the exception of the external orifice, its narrowest point. A sound corresponding in size is passed without difficulty through the external meatus, because, from its being exposed to view, the instrument cannot fail to be duly directed in the axis of the canal; but when the bec has arrived at this narrow point, the eye guides it no longer, and if the correspondence between the bec of the instrument and the axis of the tube be not exact, or nearly so, it is arrested at some part of the rim of the aperture in the triangular ligament. If the deviation from the axis be considerable upwards, the bec of the instrument will abut upon the anterior surface of the triangular ligament: this mis-direction of the point of the sound is favoured by the separation of the cavernous bodies as they diverge from each other towards the branches of the pubis, leaving a small space unprotected just before the symphisis. The handle of the catheter, however, must be thrown back in an unwarrantable manner before any injury can be done to the urethra under these circumstances. If, on the contrary, the deviation be considerable downwards, the bec abuts against the horizontal perineal fascia, with which the triangular ligament is continuous, or it sinks into the depression of the bulb.

These obstacles are more or less considerable according to the age of the subject. In infancy, and at all periods before puberty, the parts surrounding the urethra are so undeveloped as to leave the canal nearly of a cylindrical form, somewhat enlarged towards the bladder. An instrument introduced into the canal while it is so circumstanced meets with no obstacle, provided it be made to advance in the course of its axis. But in old age these obstacles have attained their maximum of development; the excavations are deep, the prostate is enlarged, the curvature of the canal is increased, the mucous membrane is loose and soft, and its surface so ample as to cap the extremity of the sound and be easily carried forward upon its point. The different periods of life, therefore, have an undeniable influence as to the ease or difficulty with which catheterism may be performed. It will be more easy, *cæteris paribus*, to sound a child than an adult, and an adult than a man of advanced years.

The third kind of obstacle arises from spasm. The modification of vitality on which this phenomenon depends, in so far as it creates an impediment to the progress of an instrument, is confined to the muscular portion of the urethra and the vesical sphincter. The sphincter may be spasmed, undoubtedly, but the force with which it acts will not be sufficient to prevent the passage of an instrument well directed, if it be not seconded in its resistance by the accidental membranous productions that sometimes exist in this situation, or by an anormal increase of the transverse fibres of the neck of the bladder. Some authors speak of the stoppage of the sound by spasm of the antepubic, or spongy portion of the urethra. Contractions of a transitory nature may certainly occur here, but we are satisfied that they cannot be a cause of impediment in the healthy urethra. We are, moreover, doubtful whether the progress of a properly proportioned sound can be arrested by mere spasm in this portion of the canal, where disease or alteration of structure exist only in the post-pubic portion of the canal. This point, however, must be reserved for consideration till we come to treat of the diseased urethra.

The fourth kind is described as existing in the orifices of the ducts of Cowper's glands, and of the mucus follicles in the spongy portion of the canal. Amongst the latter, the lacuna magna in the upper part of the navicular dilatation, is set down by most authors as capable of arresting the point of an instrument. But of this presently.

The other obstacles that may prevent an instrument passing through the urethra are of a pathological character, and do not belong to our present subject, which is the sounding of the urethra free and unobstructed.

An instrument having passed the glans, enters on the spongy portion of the urethra; the obstacles, as it has been just mentioned above, which authors describe as likely to arrest it in this portion of the canal, are the orifices of the muciparous glands. These may figure in books, as obstacles, but they are not in reality such, not even in old age. We shall therefore hold no account of them, as obstacles; the point of the catheter, if fairly directed in the axis of the canal, arrives at the bulb, without experiencing any interruption. It has now to enter the opening of the triangular ligament just under the arch of the pubis, and above and behind the depression in the bulb. The kind of impediment it is liable to encounter here, has been already described. The point once passed beyond the opening in the triangular ligament, neither the depression in the bulb, nor the elevation which the urethra presents on its farther side, owing to the condensation of its tissue round the entrance of the muscular portion, nor the narrowness of this isthmus, can any longer oppose its progress. It is now in that portion of the canal which analogy assimilates to the commencement of the female urethra. The obstacles by which its progress is here liable to be impeded are relative to the sound itself, or to the urethra. The obstacle depends upon the instrument, when the direction in which it is impelled is vicious, and varies more or less from the axis of the urethra. Any considerable degree of deviation in this respect, particularly if it obtain in the evasement of the under surface, will, on account of the great extensibility and elasticity of the muscular portion, facilitate the capping of the bec of the sound, forming the *nids de pigeon* of the French surgeons. By the proper direction of the sound, whether in the male or female urethra, this obstacle is alike unknown, for it is only produced by the improper direction of the instrument. But the obstacle, which the most accurate direction cannot shield the instrument from, is that produced by the spasmodic action of this portion of the urethra. Sometimes this action is so powerfully excited, particularly when there is congestion or phlogosis of the mucous membrane, as to oppose *in limine* the penetration of any instrument; sometimes it comes on more gradually, allowing passage to a small extent, and then grasping the sound, prevents its further progress; sometimes the occlusion of the canal is not so complete as to obliterate the passage, and a small wax bougie may obtain entrance, and even pass through; and sometimes the passage of the instrument is unopposed, the contraction upon it taking place slowly, but so firmly as to imprison it in the urethra.

At the entrance of the prostatic portion there is a very slight degree of narrowing, but there is nothing capable of arresting an instrument, on the score of mere narrowness, to an equal extent as at the isthmus. It must be observed, however, that the under edge of the gland may be so raised as to produce a considerable inequality of level, in the under surface of the muscular and prostatic portions; this obtains most in cases where the prostate is much enlarged. In describing *the fixed portion* of the urethra (see that article), it is stated, that from the neck of the bladder to the under part of the symphisis of the pubis, it forms a gentle curve. This description will be found correct, if we speak of the urethra in the adult; but if applied to the urethra of old age, it will require some qualification. The orifice of the urethra, at the neck of the bladder, lies in a plane, several lines higher than the portion of the canal that passes under the symphisis. In aged persons, the distance between these two points, is not only increased, but the level of the internal orifice may ascend still higher, by half an inch, or even more. The curve of the whole fixed portion is thus not only much augmented, but the regularity of its line on its under surface is interrupted by the anterior edge of the prostate, which breaks the whole curve into two lesser curves, including the muscular and prostatic portions respectively: this elevation of the anterior edge of the prostate, a consequence of its general augmentation of volume, may present a bar to the entrance of an instrument into the prostatic portion of the urethra.

Once over this edge, the instrument, if directed in the course of the axis of the canal, will now advance unimpeded to the sinus, at the base of the verumontanum. It must be remembered that this fleshy eminence occupies the middle of the circumference of the canal, on its inferior surface, and that the instrument, in order to pass into the bladder, must either course by the side of the comb, or ride over it, by first depressing it. The catheters now in use are not of the form best calculated to render this manœuvre easy and painless, as it should be; in the sequel we shall describe the shape of catheter employed by ourselves and others of late years, with a view to render catheterism easy, not only in respect of this specific difficulty, but to adopt it for riding smoothly, and without hitching, through the other depressions that occur in the course of the urethra.

Having passed or depressed the verumontanum, the catheter glides into the bladder, over the smooth floor of the prostate. But the case is otherwise when the transverse portion of the gland is enlarged and uplifted,—when the *luette*, by adding to the elevation of the transverse portion, increases the curve of the urethra,—when irregular membranous productions are carried forward, from the sides of the sinus, at the base of the verumontanum, or,—when, in fine, there happens to be any accidental inequality of this posterior part of the prostatic urethra. When any of these impediments exist, our sole resource, when using the ordinary instrument, is to aim at avoiding them, by altering the plane in which the point of the instrument is directed, keeping it pressed to the upper surface of the urethra. With a catheter, shaped in the manner just alluded to, we have the further power of depressing and effacing them.

The difficulties of catheterism, arising from deviation or distortion of the course of the urethra through the prostate, have been already alluded to. These deviations obtain obliquely, from below upwards, when the prostate is enlarged equally throughout its entire volume; or laterally, when the gland is enlarged on one side only. Deviations in the course of the urethra generally, may be produced by tumours formed in its vicinity. We have seen the urethra turned from its usual course, in consequence of an inguinal hernia, a hydrocele, malformed penis, &c., but these are exceptional cases, and do not belong to catheterism, considered in a general manner.

It has been already stated that the extensibility of the urethra was limited, by the nature and fixity of the parts by which it is surrounded. Bearing this fact in mind, we can readily understand how the canal is lengthened and rendered loose in old age. In advanced life, the venous system generally is engorged, the veins of the penis are varicose, the vessels of the cavernous bodies have become flaccid, and are considerably dilated; hence, all the pendulous portion of the penis is capable of considerable elongation. The same condition of parts prevails also in the fixed portion of the urethra, and to such an extent, particularly when the prostate is enlarged, as to carry the termination of the urethra in the bladder to a greater distance from the pubis, and to elevate it more towards the hypogaster; under these circumstances, a catheter of but the ordinary length, may fail to reach the bladder.

The length of the catheter should, therefore, not be alone relative to the age of the person on whom it is to be employed, but also, to the condition of the canal itself, and that of the parts surrounding it. A catheter, five or six inches in length, will answer for a child; the adult age requires one of double that length; and in the condition of the urethra just described, a still longer instrument is required. For the purpose of smooth and easy sounding, the catheter should be chosen of a size that will nearly equal the diameter of the urethra, in the adult, and more especially still in advanced age. A large instrument, when not disproportioned to the calibre of the canal, developes its walls fully, and unfolds the lining membrane, in an uniform manner, and thus the stoppages, that a small instrument is liable to on the slightest misdirection, are wholly avoided. This rule should always be attended to when we are called on to perform catheterism extemporaneously; but when circumstances require the instrument to be left in the canal for any length of time, the advantages for facilitating the introduction derived from our choice of a full-sized instrument, are counterbalanced by the greater ease with which one of smaller diameter is borne. The precept here recommended is one of greater importance than is generally imagined. There can be no doubt, that in many instances, where a catheter is supposed to be arrested by spasm in the course of the canal, and where the surgeon accounts to his patient and to himself for the circumstance on this account, that no such stoppage would have at all taken place, had he employed an instrument of larger size. Spasm, indeed, but seldom, and perhaps never, except when coincident with congestion or phlogosis, opposes any prolonged and effectual resistance to the passage of an instrument directed by a practised hand.

In laying down any rule for the surgeon's guidance in performing catheterism, the degree of curvature, or the straightness of the instrument, must, for obvious reasons, be taken into account. To illustrate this point, let us suppose, in the introduction of the catheter, that its bec has arrived under the symphisis pubis, the handle of the catheter must now be lowered down between the thighs, before it can complete its course onwards to the bladder. Now this movement of lowering the handle must be less or more extensive in proportion, as the catheter is more or less curved, and the most extensive, if it be altogether straight; or, in other words, the extent of the movement of lowering, will be inversely as the extent of the curve, and *vice versâ*. When we employ a catheter, whose bec forms a rapid and prolonged bend, from the axis of the straight part of the instrument, the bec arrives in the bladder before its handle is brought down between the thighs, so that if the patient be recumbent, the urine must ascend directly against its own gravity, which it sometimes will, being forced upwards by the strong contraction of the bladder. When the bec has arrived in the bladder, if the shaft of the catheter be brought down between the thighs, the bec ascends behind the pubis, and as the eye of the instrument may then be raised above the level of the fluid contained in the bladder, it cannot of course find issue. With a catheter of considerable curve, the bladder cannot be completely emptied in the recumbent posture; neither can the lower part of the bladder be properly examined, in order to detect a stone, with sounds of a deep-curved shape: instruments for this purpose should be short enough in the curve to admit of being turned entirely round in the cavity of the bladder, a manœuvre which cannot be accomplished with a deep-curved instrument.

In introducing a catheter of considerable curve, the movement of lowering the handle is short, and comparatively of limited extent; if the catheter be such a one as I am in the habit of employing, the curve of which is little more than that of a female catheter, the lowering movement must be augmented to counterbalance the diminution of the curve; if a straight instrument is made use of, the lowering movement must be so considerable, in order to compensate for the curvature of the canal, as to describe the best part of a semicircle.

If we compare the upper and under surfaces of the urethra, we shall find that they differ from each other in certain respects, that have not been yet alluded to. The inferior wall of the urethra not having any solid support, is soft and ample, and the bec of the catheter, while passing upon it, readily lifts it up, carries it off from the circumference of the canal, and the point of the sound being thus capped with the membrane, if the force be continued, it must be torn. The disposition of the superior surface, on the other hand, favours the passage of the instrument towards the bladder in a remarkable manner. It offers no depressions, no prominence of the prostate, no mouths of glands, no inequalities of surface, to arrest its progress, for the longitudinal folds, in which the muscular portion is thrown, when at rest, are unfolded in the lateral directions, by the bec of the catheter, and, therefore, as respects catheterism, they do not deserve to be ranked as obstacles. But even supposing the bec of the catheter to be so much misdirected, as to point directly against the upper surface, still the solid support it derives from the cavernous bodies,—from the symphisis pubis,—from the triangular ligament,—and from the dense organization of the muscular portion, is such, that the laceration of this wall of the canal could not be effected without the most extreme violence.

Hence it is, that on attentive examination of the false passages made during life, or after death, we find them invariably on the under surface of the canal, and, for the most part, leading out of the normal depressions that occur in its course. From the preceding remarks, the importance of the rule is obvious, of keeping constantly to the upper surface of the canal, as the best guide for our instrument, when catheterism is performed with a curved sound. In adhering to the direction, however, the bec of the sound should not be made to rest on, or point too much against the mucous membrane, for this would excite pain, though it could not rupture the passage. Our chief aim should be, when the bec of the instrument enters the isthmus of the urethra, (and until it arrives at this point, we do not contemplate any impediment to its progress, in the method I mean to propose) to have a perfect correspondence, when we begin to bring down the handle of the sound, between the concavity of the instrument and the convexity of the urethra. This is indispensable to the proper direction of the instrument. As the hand is lowered, the point of the catheter beyond the pubis is upraised; a slight and suavid impulsion is now all that will be necessary to make it glide without effort or check into the bladder, and without the surgeon's hand ceasing to have the consciousness of the gentle pressure which the point of the instrument makes on the *guiding* wall of the canal.

Position of the patient for catheterism.—Before we take a view of the several processes recommended by authors for the performance of the various modes of catheterism, let us examine the position best adapted for the subject on whom the catheter is about to be employed. It may be asserted generally, that the position most favourable to easy catheterism, is that in which the abdominal muscles, the suspensory ligament of the penis, and the muscles of the inferior extremities are fairly relaxed; and that position is the recumbent one, in which the head and pelvis are elevated, the thighs half flexed upon the trunk, and kept asunder, the knees being thrown out. When the patient is thus placed, if pressure be made with the left hand on the pubis, and directed downwards on the face of the bone, all the relaxation that can be had by position will be obtained. But having stated thus much respecting the advantages of a horizontal posture, it should be added, that when catheterism is performed with a curved sound, the patient may take the erect posture, sit on the edge of a table or bed, with the feet hanging down, or supported, or he may rest his back against the wall, the feet being set wide asunder, without sensibly affecting the facility of the operation.

When we make use of a straight inflexible instrument, the curvature of the urethra will be most easily effaced in the recumbent posture; but if we employ a straight, flexible instrument, such as a wax bougie or a gum-elastic catheter, without a mandrin, the patient may stand against the wall. But in all cases where a straight inflexible instrument is employed, the facility of introducing it is greatest in the horizontal position, on account of the relaxation of the suspensory ligament, which it so readily permits, if the surgeon will but take care to make pressure with his left hand down the promontory of the pubis, at the moment that the bec of the instrument arrives at the entrance of the isthmus of the urethra.

When we sound in the erect posture, with a curved silver or gum-elastic catheter, it is not necessary to keep the shaft of our instrument in exact correspondence with the median line of the patient's body, for the bec can be directed into the entrance of the isthmus or muscular portion of the urethra, while the shaft of the instrument corresponds with the hollow of the groin.

Position of the surgeon.—When a patient is sounded in the recumbent posture, authors state that there are two methods, either of which it will be proper to follow; one, the ordinary process, in which the catheter is held in parallelism with the abdomen, its concavity corresponding to the pubis, during the time that its bec is being carried down to the bulb; the other, in which the shaft of the catheter lies between the thighs, the handle being directed towards the knees, and the convexity towards the pubis, while the bec is being passed through the spongy portion of the urethra; this is the *tour de maître*, or process of sounding below the pubis; the former is the method denominated catheterism, *above the pubis.*

In the process of sounding, *above the pubis*, as it is termed, when the patient is recumbent, authors direct, if the operation is performed on a bed, that he shall be placed on the left side of the bed, and that the surgeon shall take his station on the left of the patient. This recommendation, as far as I have consulted works on the subject, is universal; many authors speak of it as absolutely indispensable.

I have no hesitation whatever in proclaiming this precept to be a bad one; indeed, of itself, it furnishes proof of the facility with which an idea once promulgated, *ex cathedra*, obtains currency, and how long its value, however doubtful, remains unquestioned. When we come to examine the matter for ourselves, we shall readily discover the disadvantages of taking our position on the left of the patient.

But to proceed with the usual description of this mode of catheterism. We are directed, when thus placed, to take hold of the penis behind the glans, between the thumb and the index and the middle fingers of the left hand, holding it at the sides so as not to compress the urethra. The catheter having been warmed and oiled, throughout its entire length, is held as a writing pen, by the right hand, in a state of semi-pronation. The left-hand now raises the penis to the perpendicular, and the right, holding the concavity of the instrument towards the abdomen, presents the bec to the orifice of the urethra, in a perpendicular direction, and thus guides it, without changing the parallelism of the shaft of the catheter with the abdomen, till it reaches the bulb. While the bec is advancing to the bulb, the left hand is engaged in drawing the penis upon the catheter. Once at the bulb, the bec can proceed no farther, till the direction is altered. This is effected by raising the shaft of the sound from its parallelism with the abdomen to the perpendicular. As soon as the shaft is vertical the bec begins to be engaged in the entrance of the membranous portion of the urethra; its further progress requires the handle of the catheter to be inclined between the thighs until the shaft becomes almost horizontal. A sensation of resistance overcome, or rather, of space surrounding the bec of the catheter, and the issue of the urine, indicate the arrival of the instrument in the cavity of the bladder. In this movement, while the handle of the catheter is describing a semicircle externally, the bec is describing another semicircle, but much less extensive in its course from the bulb to the bladder; the concavities of these two semicircles, or rather, segments of circles, face each other, and their extent is in the ratio of the straightness or curvature of the catheter, or of the urethra respectively.

When we come to describe our own mode of introducing the catheter, we shall perceive how superfluous it would be to take notice of the second mode of catheterism, viz. that, so called, *below the pubis.* The time is gone by when reputation was to be obtained by the performance of merely showy and unnecessary manœuvres. Simplicity and intelligibility are now regarded as the essential elements and best recommendations of surgical processes. The *tour de maître* belongs to those congenial times, when mystification and flourish were wont to be regarded as a guarantee for surgical capacity. We will not sanction it, even on the ground of an imaginary advantage, which some surgeons suppose it to possess in cases of excessive obesity, where the volume of the abdomen is enormous, and the penis seems engulphed in the adipose tissue that encumbers the pubis and perineum.

Recent and closer researches into the structure of the urethra, and a knowledge of the mobility of the parts surrounding it, have led to the establishment of another mode of passing instruments in a straight direction into the bladder, or of transferring (if I may be allowed the expression) the curve from the instrument employed to the hand that guides it.

The position of the patient for introducing a straight inflexible instrument into the bladder, may also be the erect or the recumbent; the latter, however, deserves to be preferred on account of the relaxation of the parts being more complete in the horizontal posture, a condition comparatively more necessary, not to say indispensable, to this mode of sounding. The shoulders and pelvis should therefore be elevated by means of pillows or cushions, while the loins should be left, in a manner, unsupported, in order to relax the muscles of the abdomen; the thighs should be semiflexed on the trunk and the knees thrown wide asunder. The surgeon places himself on the right of the patient, or between his knees, and seizing the penis in the left hand, draws it up to the perpendicular; he now presents the bec of the instrument, previously warmed and oiled, to the orifice of the urethra, and guides it down to the bulb, the instrument making the descent almost solely by its own weight, while the left hand merely holds up the penis, and is quite stationary. The bec of the instrument being now at the bulb, the first step of the operation is complete. Before any further progress can be made, the position of the catheter, which is vertical, or nearly so, must be altered; for this purpose the surgeon now removes his left hand from the penis, which it has hitherto supported, and places it, with the points of the fingers downwards, upon the face of the pubis, and with the right begins to describe a segment of a circle by bringing the handle down nearly to parallelism with the thighs, the alteration of direction being thus made to compensate for the absence of curve in the instrument. During all this movement of lowering, the bec remains pivotting in the same place, and is, in fact, the centre of the circle, of which the handle has been describing a segment. The surgeon now places his right hand in supination, and receives the shaft of the instrument as a violin player holds his bow, between the thumb and three middle fingers ; the left and right hands now act simultaneously, the former pressing down the integument of the pubis to relax the suspensory ligament, while the latter communicates a gentle impulsion to the shaft of the instrument in a horizontal direction, by which the bec is made to enter the isthmus of the urethra, and pass along the muscular portion to the anterior edge of the prostate. If there be no enlargement of the gland, no elevation of the neck of the bladder in consequence of flatus or impacted fæces occupying the cloaca of the rectum ; in a word, if the prostate be in the normal condition in which it exists in a person of from forty to fifty years of age, the bec of the instrument will, without any alteration of direction, continue to advance till it arrives in the bladder ; for the bed of the prostatic urethra, though in a higher plane than that of the muscular portion, allows itself to be depressed by the instrument, and thus the further alteration of direction of the bec becomes unnecessary. This will not be the case when the gland is enlarged to any extent, for then the bec will be stopped at the edge of the prostate, and the direction must be altered by bringing down the handle between the thighs, so that the shaft of the instrument must be impelled in a slanting direction from below upwards, before it can clear the rest of its course to the bladder. All these manœuvres must be made with suavity and gentleness. It cannot be too oft repeated or too deeply impressed on the mind of the surgeon, that in catheterism of whatever kind, the employment of force is absolutely forbidden.

New mode of catheterism.— Having now taken an extensive view of the subject, we come to propose a mode of introducing the catheter, founded on our own observations of the urethra, and differing from those above described, not only as to the manner, but also as to the rules by which we are to be guided in its performance,—a mode, the simplicity of which is not its strongest recommendation, for its value is confirmed by some extent of experience, and by the testimony in its favour of many of my fellow-practioners, whom I have been successful in inducing to adopt it.

In our consideration of the urethra it will be seen that we consider the entire canal in man as composed of a male and female portion ; the former associated with the penis, moving with it in every direction, serving for the object of sexual congress specifically, and but incidentally only for conveying the urine out of its reservoir ; in a word, the *moveable* division of the urethra : the latter, similar in structure in both sexes, in both having the same length and direction, and more or less closely attached to bones or enveloped by muscles, the *fixed*, or female urethra. Philosophically speaking, the female urethra is the type of the canal and exists alike in both sexes ; all the ante-pubic portion is but a prolongation of the tube, superadded for a purpose wholly different from that of the excretion of urine. All this anterior portion is confessedly moveable, and the admission is equivalent to a demonstration of the inutility of the rules laid down for the introduction of instruments, as far as this portion of the canal is concerned, whether it be by the ordinary mode *above the pubis*, or by the so pompously named *tour de maître*. An instrument, whether straight or curved, can be carried down to the bulb, no matter whether the direction of this portion of the canal be upwards, downwards, forwards, or lateral ; whether it be curved or straight. This point being indisputable, the question arises,—what mode of penetration is easiest for the operator and for the patient ? what mode should be preferred with reference to the fair direction of the bec of the catheter into the commencement of the second division of the canal, and its ulterior progress through this fixed portion towards the bladder ? The best, the easiest, the least painful is undoubtedly that which insures the unimpeded passage of the bec throughout the whole course from the glans to the bulb ; which leaves no doubt as to the bec arriving at this point without stopping short of it or going beyond it, and which places it most favourably by the performance of a very simple manœuvre, for falling directly into the opening of the triangular ligament.

Our reason for finding fault with the position which we are directed to take on the left side of the patient will now be best explained. The patient being on the left edge of the bed, the surgeon places himself on his left, opposite the pelvis. Now if the penis is held between the fingers of the surgeon's left hand, it is evident that the motions of his right hand must obtain from right to left, or across the front of his own body ; the inconvenience is not felt so much while the catheter is advancing through the moveable portion of the urethra, when the left hand principally is at work, but when the handle is brought down from the abdomen and the bec begins to turn under the arch of the pubis, the hand comes into a state of pronation, which is the most inconvenient for the movement of impulsion onwards towards the bladder, and this movement of impulsion is the very reverse of the first movement, for it proceeds again across the operator's body, but in an inverse direction, *i. e.* from left to right. The force of a bad precept is here fully shown, for who, without having been previously misled, would have ever thought of directing the catheter from the patient's left side with the right hand in pronation? It would be difficult to account for the origin of the precept unless, perhaps, it had been first broached by one of the old surgeons, who, not contented with the difficulties inherent in the process, was anxious to increase them *pro Deo et Humanitate*.

Upon the division of the urethra into the *moveable* and *fixed*, or ante-pubic and post-pubic portions, must be founded every rule for the introduction of instruments into the bladder, which is not dictated by fashion or put forward on some plea of imaginary convenience. Impressed with this conviction, we take it as the basis of the method which we shall now describe.

In our mode, the patient being in the recumbent posture, the surgeon stands on his right. The relaxation of the parts having been procured in the manner already described, he seizes the penis behind the glans, between the ring and middle finger, while the index finger and thumb, set on opposite sides of the glans, uncover the orifice of the urethra. The glans being inclined towards the right thigh, the surgeon, holding the catheter like a writing pen, in an arch over the right thigh, presents its bec to the orifice of the glans, which is already turned to meet it. Throughout the whole course which the catheter has now to run, its bec glides upon the right side of the canal, the concavity of its curve looking to the right side, while the curve itself is seen arching the canal above the scrotum, until the point arrives at the bulb.

The ease, brilliancy, and lightness of execution of catheterism depends entirely upon the manœuvre now to be performed, of passing from the bulb to the entrance of the muscular portion,—the sill, as it were, that divides the whole urethra into its male and female portions. The shaft of the catheter is now resting over the thigh, but not in contact with it, and its bec is in the bulb.

It must be lifted from the thigh, and brought up to the perpendicular by a movement of a quarter of a circle, the centre of which is the bulb; in other words, the handle of the catheter moves round a quarter of the base of an inverted cone, while the bec pivots on its apex. But these movements, though described as distinct, must be made to follow each other without interruption; they must not be executed, as if they were two " times " of the same process, but must run into and blend finely with each other, so that the movement of lowering, in which they terminate,—that movement in which the handle of the sound is brought down from the perpendicular till it lies inclined between the thighs, shall either bring the bec exactly into line with the muscular part of the urethra, when by a gentle impulsion applied at this part of the movement, it is propelled directly into it, or toppling on the right edge of the aperture in the triangular ligament, as it were on the edge of a bowl, it falls into it.

There will of course be some variation of the process, where the patient is sounded in the erect posture. In such case, the surgeon may prefer introducing the catheter in a line with the hollow of the groin, instead of arching it over the thigh; but the variation will merely consist in the instrument describing a lesser fraction of the circle, while the hand is bringing it up from the groin to the perpendicular.

It will be remarked, in the description of our mode of catheterism, that we take no notice of the capping of the bec of the catheter, and its stoppage by the folds of the urethral membrane, in its course from the glans to the bulb, and the reason is simply because it never occurs. The bulk of the catheter itself, and the direction given to it, which is visible throughout the whole of this part of its course, are effectual securities against such an occurrence. Neither do we join in eulogizing "that admirable and legerdemainlike consent between the operator's hands, the one hand guiding the catheter onwards, while the other is drawing the urethra upon it, in the same fashion as Sir C. Bell says a fisherman worms his hook." We do not think that " the great art of sounding," as Ledran says, " is to establish a kind of concert between the hand that supports the sound, and that which guides it, a sort of understanding, by which, alternately, the sound is urged onwards in the urethra, and the penis is drawn on the sound." On these points we have no specific recommendation to offer, and being equally convinced of the innocuity, as well as inutility of this manœuvre, we leave the surgeon to act as he pleases with respect to it, well knowing that he will be equally successful, whether he draws the urethra on his catheter, with the left-hand, or whether he holds the penis motionless, while he is directing the catheter with the right. We differ entirely from Ledran, and all those who have since repeated his recommendation of this manœuvre; it has, in reality, nothing whatever to do with the art of passing a catheter well.

The whole art of sounding in an easy and uninterrupted manner depends upon the smooth carriage of the bec of the catheter from the bulb, through the isthmus, or entrance of the muscular part of the urethra. This, beyond all doubt, is the touchstone of good and graceful catheterism. Great gentleness, and the delicate tact, which habit gives, are necessary at this point of the operation, not alone because the instrument has at the same moment to enter the narrow part of the urethra, and hook its sudden turn under the pubis; but because, at the approach to this narrow part of the canal, the dilatation is suddenly contracted, the structure of the urethra becomes all at once more dense, and the rim of the opening itself is more resisting than the parts surrounding it.

When the movement of lowering the handle of the catheter is being made, it should be accompanied, but not just at first, by an extremely light impulsion onwards, as the catheter ought to be made to advance, as much, if not more, by its own weight, than by any force communicated to it. It should not be held stiffly. The operator, if he be not expert, must not be too eager to direct it, but rather abandon it a good deal to itself. The surgeon who does so, even though he should be all but inexperienced in the matter, will rarely meet with difficulties; he who does not, will create them where they really ought not to exist. The weight of the catheter will be found a trustworthy accomplice in assisting its own introduction, and the single index finger will be often all-sufficient to urge the handle of the catheter, if the "mind's eye" directs the bec.

A practised hand will never fail to strike the opening of the isthmus, and following up the manœuvre, hook the pubis with the concavity of the catheter. But before the hand is familiarized with the movement above-mentioned, it is barely possible that the bec of the instrument may not take the entrance of the muscular part of the urethra so fairly; in which case, the bec is stopped by some point of the rim of the opening of the triangular ligament, or still remains in the depression of the bulb. When this happens, the catheter should be withdrawn a little, or even may be replaced in the same position over the right thigh, as when its bec first arrived in the bulb; the movement of lifting it from the thigh, and inclining it backwards between the thighs, should then be repeated, and the bec carried onward on a higher level, pressing against the upper surface of the canal. But above all, in the attempt to enfilade the eye of the triangular ligament, we should be anxiously careful at the same moment to bring its lower edge as level with the floor of the bulb, and its upper edge as even with the whole upper surface of the urethra as possible, by pressing with the fingers of the left hand down the face of the pubis; this movement is of the utmost importance, and indeed may be regarded as indispensable, whether for curvilinear or rectilinear catheterism, to the uninterrupted and easy passage of the bec of the instrument, from the *moveable* to the *fixed* portion of the urethra. If, again, this attempt should prove unsuccessful, we should examine the perineum, calm the patient's mind, if he should be unusually alarmed or agitated, and stay proceeding for a little while. Authors affirm that the bulbo-cavernous muscles, and the muscles of the fixed portion of the canal, will often render the progress of the instrument impossible. I have no doubt the bulbo-cavernous, as well as the other muscular structures of the urethra, under certain conditions, do act independently of the control of the will, and consequently they may be the seat of spasmodic action. This I firmly believe, but I, at the same time, as firmly reject the idea of spasmodic, or exaggerated vital action in these muscles, being an obstacle to any considerable, much less to an invincible extent, to the passage of a catheter. From long experience on this point, I am much more inclined to find an explanation of the stoppage of the catheter, in the bad direction of its bec, or in the existence of an obstacle of more permanent nature than in the spasmodic action of these parts. I have passed instruments for the first time, on persons of the most excitable habit, and alarmed to the last degree at what they imagined they must suffer from the operation—persons in whom all docility, and all command of themselves, were paralysed through sheer terror; these conditions might be fairly considered as favourable to the highest development of spasm, yet, if the bec of the instrument was properly directed, it has not been arrested by the violent, involuntary action of the muscles: besides, if it were true that spasm often impeded the catheter in the male subject, it ought to be, at least, equally frequent in the female, in consequence of the equally strong muscularity of the parts; but this we know is not the case. The proper direction of the female catheter is sufficient to secure its sure penetration into the bladder, whatever be the force of spasm in the female urethra, to oppose its progress, and both from reasoning and fact, I am strongly of opinion that the cases are analogous, in respect to the facility of passing instruments, even though the urethral muscles should be excited to the maximum of their action. Involuntary contractions of these muscles do certainly occur, but they are not sufficient of themselves alone, without complication of any other sort or kind, to prevent the passage of a well-directed instrument.

But we were stating what the surgeon should do when the bec could not be made to enter the aperture of the triangular ligament. He assures himself at a glance, that the catheter is in the proper direction, and allows the patient to repose for a short time, while he keeps the bec of the instrument steadily pressed against the orifice of the muscular portion, which will speedily admit the bec of the instrument, if it be well-directed. We cannot encourage the practitioner to support or draw up the perineum, with the palm and fingers of the left hand, while he is moving the handle of the catheter upwards and downwards between the thighs; it is altogether unnecessary, and sometimes very painful. With the rules given above, and a little patience, every thing will be accomplished quietly, and to his entire satisfaction.

If he cannot proceed any farther with the catheter he had first chosen, he should withdraw it, and try another, larger or smaller, more or less curved than the first, as circumstances may seem to him to demand. The practised hand may care little what the degree of curve may be; but the advantages to be derived from change of instrument are these, that a larger one will expand and efface the folds of the urethra better, or if that should not be the favourable condition required, a smaller one may be allowed to pass, comparatively unfelt and unimpeded, where the first was peremptorily arrested. Choice may also be advantageously made of a gum elastic catheter, with a mandrin to give it firmness and shape. This sort of instrument will sometimes be received more kindly by the urethra, on account of its more yielding material, and more perfectly polished surface. But varying the size, form, or material, is not our only resource under such circumstances. If we cannot succeed while the patient is in the recumbent position, we must try in the erect, and *vice versâ.* But we shall not dwell any longer on this point, as from what our own experience has taught us, we are satisfied that complete success is fully within the limits laid down, when the canal is not pathologically obstructed.

We shall, therefore, at once suppose that the steps described have been duly taken, and that the bec of the catheter points fairly into the aperture of the triangular ligament, and begins its progress through the post-pubic or *fixed* portion of the canal; it now becomes the patient's duty to aid the operator, and this he may do most effectually, if he be reasonable and obedient. The muscles of the perineum and muscular portion of the urethra, whether acting as involuntary or voluntary muscles in straining, though they may not actually stop a well-directed catheter, will render its progress painful and difficult. The patient, therefore, should breathe freely, keeping his mouth open, and refrain from all effort of the diaphragm; the importance of this observation is obvious, even in the administration of lavements, for if the person cramp the diaphragm, strain, and hold in his breath, the handle of the syringe is stopped, and its contents are not propelled into the intestines. The patient must carefully refrain from stiffening himself, or straining, while the catheter is advancing.

The fact that should be now most fully present to the surgeon's mind is that of the perfect resemblance between the female urethra and that posterior portion of the canal which the catheter has to traverse; this single idea will do more to simplify his proceedings, and to render him cool and collected, than all the rules he can find in all the books that have ever been written on the subject. If the bec of the catheter be directed in the axis of the gently-ascending curve of the *fixed* urethra, while the surgeon inclines its handle downwards between the thighs, it glides onwards, as smoothly as it is wont to do in the urethra of the female, without hitch or effort, into the gulf of the bladder; this will be the case nine times out of ten. But it is our duty not to dismiss the subject in too summary a manner. We have to grapple with the case of difficulty, however rare it may be, and to point out the means by which the difficulty is to be either avoided or overcome.

We have already dissented from the opinion that inordinate vital action of the muscles of the urethra could oppose the passage of a catheter, to any considerable, much less to an invincible extent. But let us now suppose a species of mixed case. In timid, nervous, and irritable persons, let us imagine the spasmodic resistance of the muscles to be at its maximum. I have already said, that however strongly the muscles are excited to resistance, they soon relax, and the impediment which was not, even at its highest, invincible, ceases. But let us suppose the involuntary contraction, either of the muscular fibres surrounding the urethra, or of the perineal muscles themselves, to be reinforced by local congestion or inflammation in this portion of the canal, and the case alters materially; to the exaggeration of a physiological function, there is added an unfavourable pathological condition, and the passage of the catheter, which, with involuntary muscular contraction alone, was perfectly practicable, more particularly if the instrument was advanced gently, and without hurry, becomes difficult and painful. When these conditions are conjoined, as they are most commonly, in persons suffering from urethritis, or who have suffered frequently from urethral irritation, or in whom, from some remnant of those irritations still lingering in its posterior portion, the urethra is still exquisitely sensitive, the pubo-urethral muscles perform a most active part in elevating and narrowing the muscular portion of the urethra.

It was necessary to place such a case before us (although, strictly speaking, it belongs to another division of our subject,) in order to develope the rule which applies to this species of difficulty.

The bec of the catheter having passed into the isthmus is, let us suppose, arrested; any attempt to continue its course, however well directed the instrument may be, is strenuously resisted. The surgeon who has once experienced this sensation of resistance recognises it instantly. The wall of the urethra itself, when in a passive state, never communicates the same kind of feeling. The catheter is actively opposed, and if the hand of the surgeon be removed from it, it will have a perceptible tremulous, or oscillatory motion, showing at once the activity of the opponent powers.

The spasmodic contraction of itself would not have opposed a long enduring resistance to the progress of the catheter; neither would the congestive or inflamed condition alone suffice for this effect. They must be conjoined in order to stop its progress. When one or the other ceases, the route of the instrument is almost as completely restored, as if neither existed, and accordingly we observe in such cases, when left to themselves for a short time, the obstacle ceases. The congestion is not removed, of course, but the muscles, by the very violence of their contractions, are soon fatigued, they then relax gradually or suddenly, and the canal becomes so unobstructed that the catheter seems to pass into the bladder without any assistance. The duration of the spasm may be abridged by distracting the patient's attention from what the surgeon is engaged in. This will be very successfully done by seeming to suspend the attempt at urging on the instrument, holding the bec steadily to the closed canal, and asking him some question relating to his illness. While he is making his reply the contraction will cease and the catheter is in the bladder often before he has done speaking. When these means are not attended with success, the catheter may be withdrawn, and its bec and sides greased with an ointment prepared with the extract of belladonna; the perineum may be rubbed with the ointment also, or an anodyne injection thrown into the rectum. But it must be remembered that rudeness and force are totally out of the question; patience and gentleness are our best allies in such cases. The tepid bath, as relieving the spasm of the muscles and the congestion at the same time, prolonged for an hour and a half or two hours, will often prove a valuable auxiliary. In these cases we should also be mindful of the advantage to be obtained by the change of form, or material of the instrument. If the mucous membrane should be in a highly congested or inflamed state, local or general bleeding will be necessary, with fomentations, bathing, &c.

The means which we would recommend against the capping of the bec of the sound in this portion of the canal have been already detailed; they may be comprised in two words: proper direction and sufficient bulk of the catheter. If the bec should become capped by the urethral membrane, or stopped at the anterior edge of the prostate, it should be withdrawn a little way till its point is freed, and then carried onwards in a higher plane, keeping by the upper surface of the canal.

When the prostate gland is much enlarged, and the neck of the bladder is considerably elevated, it is recommended to use a catheter, the curve of which is so deep as to turn closer to the base of the triangular ligament, and follow more exactly the upper surface of the urethra; the same manœuvre may be effected with a catheter of the ordinary curve if the handle be brought low between the thighs, when its bec has cleared the triangular ligament.

When the catheter is arrested in the muscular or prostatic portions of the urethra, some surgeons place great reliance on the guidance obtained by a finger introduced into the anus. In order properly to appreciate this manœuvre, we must consider what the effect will be on the neck of the bladder and prostate of distending or uplifting the extremity of the gut. If the bec of the catheter be still at some distance from the neck of the bladder, the extremity of the finger in the anus will have reached beyond it, and as it uplifts the gland and the portion of the canal between it and the bec of the instrument, the difficulty, or rather the obstacle, will be thus increased; but if the bec of the instrument be in the prostatic portion, and stopped by the transverse ridge of the gland, the point of the finger will not, or rather need not, reach it, but will be applied against some point of the curve, it may then be used as a fulcrum, to enable the bec to mount over the transverse ridge; but this can only be safelydone by withdrawing the bec from the point at which it is arrested to the extent of about a line, before the catheter is allowed to make any leverage from the point of the finger. If any advantage is to be safely obtained from the introduction of the finger into the anus, it must be by keeping the finger after having fully explored the position of the bec of the catheter perfectly still, and applied against its curve at some distance from its point; in this way only can it render any service in clearing the catheter, at the anterior edge of the prostate,—at the base of the verumontanum,—and at the ridge of the transverse portion of the gland. When a straight instrument is employed, we should carefully avoid this manœuvre altogether, as it would counteract what we had in view, namely the effacement of the curvature of the canal.

The rules described for the guidance of an instrument through the post-pubic portion of the male urethra will be equally applicable to its introduction in the female, with some slight difference in respect of facility in favour of the latter on account of the absence of the prostate gland. We should not omit to observe that the concavity of the canal, in both sexes corresponding to its superior surface, is now and then reversed in the female; this happens, even though she be not pregnant, when the external orifice is drawn back into the vagina. When in these circumstances a necessity arises of using the catheter, the accidental curvature must be corrected by passing the finger into the vagina and feeling for the orifice of the urethra, or the small tubercle which sometimes surmounts it, and pressing downwards and outwards; the instrument may be then introduced, and the operation performed in the usual manner.

I come to the description of a new form of catheter, the advantages of which, as adapted to the depressions and eminences of the urethra, will be obvious to any person who has previously taken the trouble of making himself acquainted with the anatomical configuration of the canal, upon which the instrument itself is closely modelled.

I have already said, that if the direction of the urethra was straight, and its diameter equal throughout its entire length, that our rules for introducing instruments into the bladder might be expressed in a single sentence, viz. to take an instrument suited to the calibre of the canal, and direct it in a straight line, from its external to its internal orifice. But the canal of the urethra is not straight, neither is its diameter equal. The problem to be solved, therefore, presents itself thus:—the canal of the urethra being curved, and diameter being normally unequal in consequence of depressions and elevations of its under surface and circular narrowings—which is the best form of instrument to be employed with a view to the effecting an easy and uninterrupted passage through this tube?

The catheters already in use being commonly of equal diameter, and rounded or oval at the point, present the same unvarying relation to every point of the canal whether it be narrowed or dilated; and hence the obstacles (natural obstacles, as they are termed) that oppose the progress of the instrument upon the slightest misdirection of it in those points of the canal where its diameter varies abruptly. I have had a fair share of experience of this subject and have thought much upon it, and no doubt now remains on my mind of our possessing the power of obviating the difficulties of catheterism, as arising from these obstacles, by the form of the instrument which has now been for some time subjected to the test of daily use.

In speaking formerly of the choice of a catheter I dwelt much on the importance of its bulk; the largest, when not disproportioned to the calibre of the canal, being in general the best. The reason of the preference is obvious[1],—the large instrument, according as it advances in the urethra and unfolds the membrane, forms a small vacuum before its bec, and thus its route is opened and prepared for it in a manner which does not obtain when a small instrument is employed, for in the latter case the folds of the canal are in close contact with its point.

The qualities that seem to me desirable in the catheter are the following:—

First, the volume, or size, should be full, in proportion to the calibre of the urethra.

Secondly, its shape should be such that the small vacuum in advance of the bulk of the catheter, and produced by it, shall be occupied by a small guiding prolongation of its point, inclined to the upper surface of the canal.

Thirdly, on its under surface its shape, between the tip of the small prolongation and the part at which its fullest diameter is developed, shall be such as to occupy or accommodate itself to the depression as it passes them, and to depress and flatten the eminences on the under surface of the urethra as it passes over them.

Fourthly, that the eyes shall not be too large, and that they shall be so placed as not to present any obstacle to the progress of the sound, either by their being plugged or stopped up by the lining membrane of the urethra.

It will be evident on examining the catheter I propose (see Fig. 170), that its form fulfils all the conditions required in relation to the canal in its passage down to the bladder.

Its form in all respects is the same as that of an ordinary catheter, except from the eyes to the termination of the bec, and in this portion its shape is entirely different from that of the instrument in general use. The whole of this portion consists of three parts, a neck, head, and beak, and bears a strong resemblance to the neck, head, and bill of a swan.

When a catheter of this shape is passed into the urethra the bulk of the head is sufficient to unfold the membrane in advance of it; the bill occupies the vacant space thus made, and continues to move along smoothly in contact with the upper surface of the urethra, from which its extreme point is so fashioned as to incline slightly towards the axis of the urethra. When it arrives at the bulb, the bulk of the head occupies this depression, while the guide or bill is necessarily directed into the middle of the isthmus, or commencement of the *fixed* portion of the canal; the handle being now gently lowered, the bulk of the head ascends out of the depression of the bulb, and favoured by the inclined plane, in which the head and bill are blended together, glides imperceptibly over the sill formed by the under edge of the triangular ligament. It moves on freely through the muscular portion till it reaches the prostate; here again, the guide, keeping close by the upper surface, overtops the eminence of the verumontanum, and depressing it, leads the head of the catheter gently over it. The bill then enters the bladder at the upper part of its orifice, making way for the head of the catheter as it had done throughout the whole of the passage. To resume: the chief and valuable peculiarity of this catheter consists in the fidelity with which its upper surface keeps to the upper surface of the urethra, while the bulk of the body, tapering upwards to the end of the bill, successively unfolds the depressions and climbs upon the eminences which it meets in its course along the inferior surface of the canal.

Sounds of this shape may be rendered still more useful by adapting to their external end a small caoutchouc bottle about the size of a walnut filled with oil, tepid water, or a solution of extract of belladonna. This arrangement, though merely accessorial, may be very useful when the operator is inexperienced, or when there is spasm with congestion of the muscular portion of the canal. It will also form a good substitution for forced injections in cases of retention of urine; and a very good preparative for the passage of very fine bougies or catheters.

In developing these opinions my object has been to contribute something, however inconsiderable, to render more easy of execution an operation often requiring great delicacy of tact, and which is but too often rendered unnecessarily painful and difficult. Under this impression I should have preferred fatiguing the attention by presenting the whole subject in some detail, to failing, perhaps, in my object by curtailing points which I believe to be important. If I might venture to add one more recommendation, I should advise those who have still the resources of the dissecting-room, and who are desirous of excelling in this important part of a surgeon's duty, to make frequent trials on dead subjects of different ages. An excellent method for this purpose is practiced in the amphitheatres on the continent, which consists in removing the thigh of the left side and laying the urethra bare. He will then see clearly the nature of the obstacles that he has to encounter at the bulb, the isthmus, and the prostate, and speedily learn to overcome them. The catheter above described has been made for several years back by those excellent makers, Philp and Whicker (Savignys). Some surgeons have had the head of this catheter adapted to the ordinary one; an arrangement which adapts it to the pocket-case, in the same manner as different shapes of curves are screwed to the common shaft.

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[1] Vidi aliquando me instrumento parvo ad vesicam penetrare non potuisse, cum tamen magnum, et crassum, citra ullum impedimentum, et obstaculum immissum fuerit: causa est quia tenerum et gracile instrumentum anfractibus et rugis virgæ impingit; crassum vero uretram diducit, et per se aperit.—*Fab. Hild.* lib. de Lith. cap. iii. p. 712.

Fig. 170.

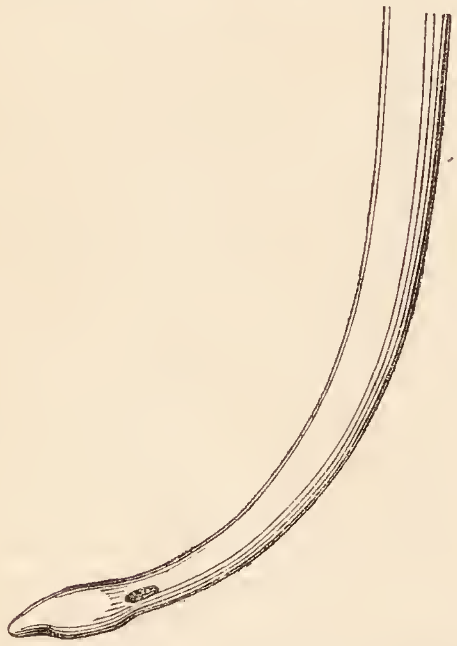

Fig. 170 *represents the curved portion only of the self-guiding Catheter.*

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CATLING, or Catline, a long, narrow, sharp-pointed, two-edged knife, employed in forming the flaps in amputations, and in dividing the soft parts between bones, as in the fore-arm and leg.

CAT'S-EYE. See Amaurosis. In addition to what is said on this subject, in the article referred to, it may here be mentioned that this term designates an appearance merely, and that by no means characteristic of any one disease of the eye. Beer[1], who describes cat's-eye as the type of his second class of forms of amaurosis, viz. that characterized not only by subjective but also by objective symptoms, mentions having met with it most frequently in old persons inclined to marasmus, but sometimes in young persons, especially cachectic adults and atrophic children: he had also seen it after injuries of the eye. The appearance of cat's-eye occurring after injuries is owing to a non-malignant deposition or tumour at the bottom of the eye[2], which is quite different from the condition, whatever this may be, which gives rise to the appearance in old persons[3]. "I have," says Dr. Mackenzie (Treatise, 3rd ed, p. 777), speaking of the affection in old people, "seen this sort of cat's-eye both in eyes which retained vision and in amaurotic eyes."

CAUSTICS, καυστικὸς, from καίω, I burn; *Aetzendesmittel*, Ger. By caustic is meant a substance which has the quality of combining with the principles of organized matter, destroying or modifying its texture, and determining effects not unlike those produced by fire. This property belongs to concentrated mineral acids, pure alkalis, or their hydrates and certain metallic salts. As remedial agents, these were first introduced into practice about the middle of the fourteenth century.

Caustics, according to their degree of energy, have been divided into catheretics and escharotics; the former derived from καθαιρέω, *detraho*, denoting a mild application, while the latter from ἐσχάρα, *crusta ex adustione vulneri adhærens*, are capable of a very violent action. This division has been justly impugned because the same caustic, according to its degree of concentration, the length of time it is applied, and individual peculiarities, may be made to exercise either a catheretic or an escharotic action. Thus, for instance, the hydrate of potash slightly passed along the skin will remove nothing more than the cuticle, while its abiding contact will corrode, penetrate, and dissolve the subjacent soft parts to a considerable depth.

Caustics are used in surgery to arrest hæmorrhage, to form an issue, to open an abscess, to erode the surface of a sore, and to destroy morbid growths.

Hydrate of Potash, or Caustic Potash, as it is commonly called, is a powerful escharotic, whence its old name of *causticum commune acerrimum*. While it penetrates deeply it occasions little local excitation, but tends to produce in enfeebled parts contiguous to the resulting eschar, a remarkable tendency to what is termed purulent softening and decomposition. It is a useful application to scrofulous sores of a torpid character, when the surrounding integuments are undermined and shelving, and to wounds or abrasions contaminated with animal poisons. In the latter instance it ought to be freely insinuated into the breach of surface; and after a while any remaining excess should be carefully wiped off with dry lint, in order to prevent its spreading over the sound integument. A cylinder of this caustic, tapering to a point, may be efficaciously employed to open an abscess. By such procedure room is made for a free and complete discharge of matter; and the sinuses, jagged lips, callous and inverted edges, so frequent a sequel of the use of the knife, even in the most healthy subjects, rarely occur[1]. Zöhrer earnestly recommends this practice in the instance of glandular abscess, occurring in a strumous habit of body[2]. I have thus cured buboes with great promptitude.

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[1] Lehre von den Augenkrankheiten, vol. ii. p. 495, Wien, 1817.

[2] This variety is that which serves as the type of cat's-eye among the wax preparations of diseased eyes in the Museum of the Ophthalmic Clinik at Vienna.

[3] This variety of cat's-eye is represented by Ammon in his Klinische Darstellungen der Krankheiten des menschlichen Auges, vol. i. pl. 15. fig. 10, 11.

In a paper published in the ninth volume of the Transactions of the Medical and Chirurgical Society, Mr. Wardrop proposed the cure of nævus by the process of artificial ulceration; and for this purpose recommended the *kali purum*, or hydrate of potash. It is sufficient to apply the caustic only to a small point of the tumour, for which purpose a piece of adhesive plaster, with a hole cut in its centre of sufficient size for the application of the potash, should be placed on the tumour which serves to limit its action to the desired extent. This done, the potash is to be rubbed on the skin, until a sufficient action is distinctly produced, which is indicated by its discoloration. If in two or three days it is found that the action of the potash has not been sufficient, it may then be re-applied and rubbed on a greater extent of surface, or with greater force, thus securing the formation of a larger and deeper slough. In this manner it may be used any number of times, and it is surprising, after a complete slough has thus been formed, how rapidly the subjacent tumour melts away. It is not requisite that the dead portion should separate and leave the ulcerated surface exposed; on the contrary, the slough should not be meddled with, as it forms the best dressing, and the ulcerative process will be found to go on, imperceptibly as it were, underneath it, its progress being indicated only by the collapse of the tumour. No bleeding takes place during this process, as the extremities of the vessels become gradually filled up with coagulated blood, in proportion as the ulceration advances in the mass, and the cells of the parenchyma are filled with coagulated blood, the circulation through these having been arrested. This practice has proved successful in cases of very large nævi. Chopart suggested an ingenious plan for the removal of tumours by means of ligatures imbued with caustic[1]. Potash thus applied, according to him, acts with more activity than when placed solid upon the skin. Where the tumour is sufficiently prominent to be embraced by the medicated ligature, we may thereby perform a kind of amputation, more tedious and painful perhaps, than with a knife, but in skilful hands equally sure of success.

Cauterization with this substance has been employed by Dr. V. Kern for diminishing the inguinal aperture, in the case of large reducible herniæ with wide sacs[2]; by Dr. Hesselbach for inducing inflammation and sloughing of the tunica vaginalis, in order to effect a radical cure of hydrocele[3]; by Professor Dzondi, for the purpose of healing congenital fistulæ of the trachea, after previous dilatation of the fistulous passage[4]; by Solera, for the removal of trichiasis, the stick of caustic being incased in sealing-wax or shell-lac[5].

This caustic is generally preferred for forming issues; and the most convenient mode of employing it for that purpose is to apply to the skin a piece of linen spread with adhesive plaster, having a circular opening in its centre corresponding to the intended size of the issue; and then to rub upon the skin, within the opening, a piece of the caustic previously moistened at one end, as in the case of nævus. The application is to be continued till the life of the part is destroyed, when the caustic should be carefully washed off. Poultices are afterwards to be applied till the separation of the eschar, which, if moderately thick, is seldom affected before twelve or fifteen days.

Hydrate of Soda is an efficient escharotic, adapted for the same purposes as the caustic potash; being less deliquescent it is more manageable than the latter.

Quick-lime is occasionally employed as a caustic. Slower and less profound in its action than either of the alkaline hydrates we have been describing, it keeps up a kind of *smouldering* heat in the part, and produces a dirty-green eschar, which comes away upon the poultice in gluey filamentous shreds, after the lapse of eight or ten days. Such were the phenomena I perceived in a case of scirrhous breast, to which I applied a soft cake, composed of equal parts of finely-powdered quicklime and soft soap. It effected a partial separation only of the diseased mass. Canquoin's formula is three parts by weight of quicklime mixed with two parts of dry soap, both reduced to the pulverulent state. This is to be diluted with a little rectified spirit of wine, so as to give it the consistence of thin pap; it is then to be laid upon the affected part, in quantity proportional to the desired effect. As this caustic seldom produces hæmorrhage or any degree of local re-action, it may be resorted to with the view of removing superficial degeneration of the skin and nævus. It probably acts by absorbing the liquids, and giving rise to gangrene of the part.

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[1] Clare P. An Essay on the Cure of Abscesses by Caustic, and on the Treatment of Wounds and Ulcers; 8vo. London, 1799.

[2] Das Heilverfahren gegen die scrofulösen Drüsengeschwülste und Abscesse. Vienna, 1829. p. 56.

[1] Prix de l'Académie dè Chirurgie, tom. iv; Essai sur les Loupes.

[2] Leistungen der Chirurgischen Klinik, an der hohen Schule zu Wien. 1828. p. 100.

[3] Jahrbücher der Physik. Med. Gesellschaft. Bd. i. p. 76.

[4] De Fistulis Tracheæ Congenitis. Halæ, 1829. p. 15.

[5] Archives Gén. de Médecine. vol. xxi. p. 418.

A compound, consisting of three parts of hydrate of potash, and two parts of fresh burnt lime, reduced to powder, and incorporated together in a hot iron mortar, has been recently introduced into practice under the title of the *caustic of Vienna.* It is applied in the form of paste, prepared by the addition of a little spirit. It has been found useful in eradicating cancerous growths and nævus[1], realizing all the advantages without any of the inconveniences of the fused potash.

Nitrate of Silver, or Lunar Caustic, is the most valuable erodent we possess. When placed in contact with animal matter, it is promptly decomposed; the oxide of silver remaining on the surface, and by exposure to the light, becoming black. It is the approved application to ulcers in which the granulations are luxuriant and spongy. To this end, the fused cylinder of the nitrate is to be passed with a light hand over the surface of the sore, care being taken to touch the more salient portions only, so as not to erode the cicatrice already formed, and retard the healing process. The filmy eschar comes away during the interval between one dressing and another; hence the application may be renewed every twenty-four hours, until a salutary change is perceptible. In the case of deep ulcer of the cornea, Dr. Mackenzie of Glasgow recommends the momentary contact of a pointed pencil of lunar caustic[2]. During the application, the upper lid is to be kept elevated by Pellier's speculum, and before it is allowed to fall, a little water is to be injected over the cornea. The same practice may be pursued if hernia of the cornea is present, or if the cornea is completely penetrated and hernia of the iris has taken place. In fistula of the cornea, likewise, after snipping off the projecting portion of the conjunctiva, the opening is to be touched with the lunar caustic pencil. Cauterization of the margin of the cornea has been recommended by Dr. Serres in palsy of the iris, depending on some affection of the ciliary nerves, or other branches of the third and fifth pairs, provided there is no disease of the retina or optic nerves. Forestier, Réveillé-Parise, and Demours concur in regarding this as one of the most certain means of inducing contraction of the pupil, when preternaturally dilated; and Professor Jäger has frequently employed it with success in his clinical practice, for mydriasis, the affection in question[3]. The cauterization, which should be instantaneous, is to be performed at the line of junction of the cornea and sclerotica. It is said to answer when followed by discharge of tears, and slight vascular injection of the conjunctiva, which subsides in a few days.

The lunar caustic pencil may be likewise used, in the instance of incurable lachrymal fistula, for procuring obliteration and adhesion of the walls of the sac; as also in that of relaxation or growths within the lachrymal sac and nasal canal.

In simple ulceration of the tonsils it is a most efficient remedy, and sometimes proves serviceable against the chronic enlargement of these glands, but the cauterization must be repeated at least every fifth day during some months, ere any adequate diminution can be expected.

The nitrate of silver exercises a remarkable power in allaying the increased sensibility and pain, and promoting the healing of sore nipples. Here it seems to act by forming an artificial epidermis, which shields the irritated nervous extremities against the contact of external impressions. Its influence in assuaging toothache may be explained in the same way. The free application of this caustic to the lining membrane of the vagina, has proved effectual in curing acute and chronic blennorrhœa: cauterization of the male urethra, to the extent of 2½ inches from the orifice, has in like manner been recommended by Dr. Scharlow, in, what he terms, consecutive blennorrhœa[1].

In the instance of primary venereal sores or excoriations, it may be advantageously applied within the first three or four days. It transforms the sore into one of a healthy nature, accelerates its healing, and, according to Rust, counteracts the absorption of the virus[2]. Mons. Ricord advocates this plan of treatment, for which, I believe, we were originally indebted to Mr. Hunter. The same observations apply to dissection and other poisoned wounds at an early period.

Its use has been extended to corns. After bathing the feet in hot water, we should pare away the layers of indurated cuticle until we see the skin soft and red, and the capillaries ready to bleed, the caustic is then to be rubbed on the part for a few seconds, after which it is to be covered with oil-silk. This operation must be repeated daily for eight or ten days, when no trace of the corn will remain. The ulceration of chilblains may, in like manner, be prevented by gently passing the caustic along the inflamed surface; the skin having been previously softened by the application of a compress of lint soaked in water.

As a means of arresting hæmorrhage from leech-bites, the lunar caustic has usually succeeded.

Chloride, or, as it is commonly called, Butter of Antimony, is a caustic which acts quickly and to a considerable depth, without exciting much local inflammation; and the pain, although acute at the moment, soon subsides. The resulting eschar is white, and rather soft, varying in thickness according as the chloride is more or less altered by afflux of fluids, and separating in from ten to fifteen days. Like arsenious acid and chloride of zinc, it seems endued with the property of modifying the vitality of the part to which it is applied, and of thus meliorating the condition of diseased surfaces; hence its utility in *lupus exedens*. In two instances I succeeded in permanently arresting the ravages of this troublesome and often intractable malady by its means. It suffices merely to touch the ulcerated surface with a camel-hair pencil dipped in the solution; repeating the contact at short intervals, until a healthy ulcerative process be established. Ablution with cold water directly after, has the effect of deadening the pain, by decomposing any remains of the chloride. It was formerly in great repute among oculists, for removing excrescences from the surface of the eye, staphyloma and cloudiness of the cornea, but has been superseded by other remedial agents. The cysts of the hydatid polypus have been sometimes destroyed with it. MM. Enaux and Chaussier regard it as a powerful remedial agent in the instance of malignant pustule, after the vessels of the part have been unloaded by free incisions, and the blood wiped away. It decomposes and destroys the septic animal poison, and never fails to do good, if used at an early period. A similar plan of treatment may be advantageously pursued with anthrax. It has been extolled as an efficient application in the instance of bites from rabid animals, because it rapidly penetrates into the wound, and any excess of action is easily obviated; but I am not aware that it possesses any intrinsic superiority over other caustics in a liquid state.

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[1] Lancet, 1840.

[2] Treatise on Diseases of the Eye, p. 492.

[3] Kunhardt, Ueber Mydriasis. Erlangen. 1832.

[1] Gräfe and Walther's Journal, 1839.

[2] Aufsätze und Abhandlungen; Berlin, 1834, p. 162.

Chloride of Zinc is a most powerful escharotic, susceptible of being applied over very extensive surfaces without any risk of injury from absorption, and available wherever the surgeon's hand can reach. Its operation is purely local; it rarely gives rise to any surrounding inflamation or swelling, except it be applied on the face near the eyelids, where there is much loose cellular tissue. The depth to which it will corrode the morbid texture can always be estimated beforehand; its action is unfailing; and the eschar is separated in most cases from the eighth to the twelfth day, coming away quite entire in the form of a grayish white mushroom-like substance, and leaving behind a singularly healthy sore, which heals with great rapidity. Mons. Canquoin of Paris, who first introduced it into practice[1], is of opinion that it modifies subjacent textures; it assuredly gives rise to healthy granulations and laudable pus. In numerous instances where I have applied it very largely, I have never known it productive of the slightest constitutional disturbance. The pulse remains natural, and the skin cool. The pain accompanying its action is of a violent burning character, persisting with great intensity for the first seven or eight hours: after that time, that is, when the surface is fairly eroded, it becomes supportable, as the patients express it, and continues so during the remainder of the application of the remedy. An important point is, that the pain is in a great measure under the control of opium, a full dose of that drug previously administered seldom failing to give great relief.

It has been extensively employed by Mons. Canquoin in the treatment of cancerous and other malignant diseases[1]. From considerable experience in its use, during the last five years, I am disposed to conclude that it is chiefly efficacious in those so called semi-malignant tubercles and ulcers which make their appearance about the face of persons advanced in life, where the skin is involved, but without any depth of new structure; in the circumscribed tubercle of the cicatrice following operations for cancer; in a form of lupus, which I have described[2] as the erosive ulcer of the follicles of the skin; in superficial ulceration of the neck of the uterus; and in nævus maternus. In true carcinoma, affecting glandular and fleshy parts, it will only effect temporary melioration. There perhaps the surgeon may be justified in resorting to it, where the use of the knife is impracticable, or the patient refuses to submit to extirpation by incision. Under such circumstances I have frequently found it the means of prolonging the patient's days and rendering her condition more comfortable. It has, moreover, proved beneficial in chronic ulcers and caries; and according to Dr. Hanke, in malignant pustule and syphilitic sores.

Chloride of zinc, in order that it may act with efficacy, must be applied in a concentrated form. In solution it acts merely as an irritant. Being extremely deliquescent it would become rapidly dilute, if some means were not taken to counteract that tendency. Mons. Canquoin employs wheat-flour for this purpose, according to the subjoined formulæ: 1. Chloride of zinc one part, wheat-flour two parts. 2. Chloride of zinc one part, wheat-flour three parts. 3. Chloride of zinc one part, wheat-flour four parts. 4. Chloride of zinc one part, chloride of antimony half a part, wheat-flour two parts and a half. Thirty to forty drops of water are to be added for each ounce of chloride. To prepare the *phagedenic paste*, the chloride of zinc reduced to fine powder is to be mixed as quickly as possible on a slab with the given quantity of flour. One half of the mixture is immediately to receive its proportion of water, and to be worked up progressively with a spatula, until it forms a homogeneous mass like honey. This is to be brought to the desired stiffness by trituration with the remainder of the dry ingredients, well beat up for a few seconds, and then rolled out into cakes or wafers, of from half a line to four lines in thickness. The quantity of water must be proportionally augmented according to the increased amount of flour in the second and third formulæ. The antimonial paste No. 4. is to be moulded into a crayon shape; because, as it preserves always the consistence of soft wax, a suitable thickness can be given to it, so as to adapt it to unequal and nodulated surfaces.

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[1] Mémoire sur un nouveau Mode de Traitement des Affections Cancéreuses. Paris, 1835.

[1] Traitement du Cancer. Paris, 1838.

[2] London Medical Gazette, vol. xix.

The paste No. 1, four lines thick, applied during two days, is capable of producing an eschar of an inch and a half in depth. The same paste, three lines thick, applied during the same space of time, will furnish an eschar of one inch in depth; the same compound, two lines thick, will in two days determine an eschar of about half an inch. A layer of one line in thickness will yield in twenty-four hours an eschar of three lines; while one of half a line will produce in the same time an eschar of at least one line.

These changes will manifest themselves with the above precision only in tissues endued with a considerable share of vitality, and of which the consistence is nearly normal. In the brawn-like (*lardacé*), almost fibro-cartilaginous structure, about one-third is to be deducted from the thickness of the eschar above mentioned. The paste No. 2 is employed in the instance of painful cancerous affections; and No. 3 in that of very delicate and irritable subjects.

In tumours that are voluminous and prominent, instead of applying the caustic on the anterior segment, we may surround the base with a ring of paste two lines broad and four deep; should the tumour again present a central depression, its destruction may be accomplished by using the *phagedenic paste* in a spiral form.

As the wheaten flour prescribed in the above formulæ is apt to envelop the chloride in a glutinous dough, which tends to blunt its power, or, at any rate, to confine its action to the particles on the surface of the paste, I have been in the habit of substituting anhydrous gypsum in its stead. This, while it can exercise no chemical action upon the chloride, forms a porous medium, through which the whole particles of the deliquescent chloride may transude upon the morbid surface, with the effect of decomposing or destroying it with certainty to any definite depth[1].

When the integuments are sound, the epidermis may be removed by means of a blister, and on the following day one or other of the above preparations, corresponding to the thickness of the tissue to be destroyed, is to be applied to the cutis of the diseased part. I have generally employed, as more convenient for this purpose, the caustic ammonia or the hydrate of potash. Mons. Canquoin commences in the case of tumours by one, two, or three applications of the *caustic of Vienna*, renewed at intervals of twelve or twenty-four hours. This mode of proceeding tends to accelerate the cure and to diminish the intensity of the pain. The chloride of zinc paste may be always advantageously superimposed over the last eschar formed by the other caustic. Where, on the other hand, the surface is ulcerated, he begins with the compound of quick-lime and soap formerly described; a layer of this from five to six lines thick being laid on the part for twenty-four hours.

When the operation of the paste is complete, it may be gently taken off, and the eschar covered with an emollient poultice, or if it be small, with folds of moist lint, surmounted with oil silk, until its separation; which usually happens, as formerly stated, from the eighth to the twelfth day, according to the thickness of the layer employed. The application is to be repeated again and again till the whole morbid structure is removed; after which the surface heals rapidly under the use of the water-dressing, followed by strapping with adhesive plaister. When frequent repetition is necessary, Mons. Canquoin alternates the use of the *caustic of Vienna* with the *phagedenic paste*.

I adduce the two following cases to show how completely this most powerful agent is under the control of the surgeon, both as to superficial extent and profundity. In the spring of 1838 a gentleman connected with Lloyd's consulted me, by the advice of Dr. Porter of Portsea, for a tubercular sore, about the size of a fourpenny piece, situated upon the nose, over the junction of the cartilage with the nasal bones. He had been for four months previous to my seeing him under the care of an eminent surgeon, belonging to one of the borough hospitals, but without deriving any benefit. A single application of the gypsum paste sufficed to remove the morbid surface, leaving a healthy sore, which was cicatrized in less than three weeks. The part has remained well ever since, and the scar is scarcely perceptible.

In the month of January, 1839, a gentleman, about seventy years of age, applied to me in consequence of an indurated tubercle of a dark livid aspect, occupying the surface of the left *ala nasi.* It had existed for about nine months, and was the seat of occasional darting pain. As he was desirous of having it removed, I applied a thin layer of the gypsum paste, in the presence of Mr. Parsons of Curzon-street, Mayfair. The eschar separated in nine days; and in little more than a week after, the resulting sore was perfectly healed, the semi-malignant growth being completely eradicated.

In most cases I am disposed to believe that the chloride of zinc operates, in virtue of its powerful affinity for albumen; a fact first pointed out in a paper published by me in the seventeenth volume of the Medical Gazette. It is one of the great truths of modern physiology that the vital and chemical forces are antagonists to each other, and hence those parts in which the vitality is feeble are soonest affected by chemical agents. Thus we may conceive how the morbid albumen of cancer, prone to spontaneous changes, is more readily affected than the surrounding parts, by the above phagedenic substance.

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[1] London Medical Gazette, vol. xviii.

Bichloride of Mercury, or Corrosive Sublimate, acts very superficially as a caustic, and at the same time produces considerable local inflammation. It should be applied to a surface of small compass only, otherwise it may enter the circulation and occasion symptoms of poisoning. The resulting eschar is of a pure white colour, soft, and of little thickness, separating in two or three days. The troches of minium, so serviceable in the instance of fistulous sores, following abscess in the inguinal and axillary regions, owe their activity to this preparation. The tubular eschar which ensues is uniformly thrown off upon the third day, and prompt cicatrization follows, provided a gentle degree of compression be used. The bichloride has been applied with advantage to erectile tumours, spongy excrescences, condylomata, and syphilitic sores. Plenk advises the affected part to be touched by means of a camel-hair pencil with a solution of from half a drachm to a drachm of corrosive sublimate, along with a drachm of camphor, in one ounce and a half of spirit of wine. In the instance of erectile tumour, I have seen the late M. v. Gräfe apply with good effect a paste, composed of two drachms of the sublimate, with two scruples of powdered gum arabic, and as much water. A similar paste made with two parts of gum arabic to one part of the bichloride, has sometimes promoted the healing of herpetic and carcinomatous ulceration attacking the eyelids.

An elegant method of forming a small issue is to make a longitudinal cut in the skin with the edge of a lancet, and to rub into the linear incision some finely pulverized corrosive sublimate.

The modus operandi of this caustic is analogous to that of the chloride of zinc. According to Elsner, when albumen or fibrin is submitted to its action, a definite chemical combination of these with binoxide of mercury takes place[1]. M. Lassaigne, on the other hand, maintains that the albumen unites in definite proportions with the metallic salt[2].

The acidulated Nitrate of Mercury, prepared by dissolving one drachm of the protonitrate in an ounce of nitric acid, is constantly employed by the French surgeons, under the name of the *nitrate acide de mercure*. Mons. Recamier was the first person who recommended it in the treatment of cancer. Its application is apt to be attended with considerable pain, swelling, and inflammation of the surrounding parts, and even febrile reaction. It is generally brought in contact with the diseased surface by means of a tuft of charpie, but it is difficult to prevent its spreading beyond the prescribed limits. In the instance of ulceration of the cavity of the neck of the uterus, Mons. Ricord cauterizes in the following way: he fills one of the cylinders of his double syringe with the acidulated nitrate, diluted with twelve parts of distilled water; adapting to the canula of the syringe a gum-elastic tube, about eight inches in length, which passes into the cavity of the neck. The injection is pushed gently along, in the quantity of a teaspoonful at a time, and after a minute or two have elapsed, the water contained in the other cylinder is injected without displacing the instrument. In the case of simple redness or phlyctæna, unaccompanied with inflammation, a single cauterization will suffice; but where ulceration is present it needs to be repeated five or six times[1]. This caustic is occasionally used for herpetic and lupoid ulceration.

Sulphate of Copper.—This salt, observes Canquoin[2], reduced to powder and mixed with a little saliva, so as to form a paste, is a most virulent caustic, the lancinating pain from which would become insupportable were it applied over an extensive surface. When moderate in quantity the phenomena of reaction it occasions are trifling, but then its escharotic action is very superficial. It is frequently employed to destroy fungous granulations in ulcers; as also to change the diseased condition of the surface in granular conjunctiva. When brought in contact with the *tunica adnata* it is liable to determine very severe irritation. Its use as an escharotic is confined to veterinary practice.

Arsenious Acid is an energetic caustic, producing a livid, thick, coriaceous eschar, which commonly requires eighteen days for its separation. It excites vigorously the action of the vessels of the part, giving rise to inflammation and violent pain, which occasionally persists for five or six days. A remarkable phenomenon attending its employment, is a more or less copious exudation of coagulable lymph after each application. Independently of its escharotic quality, it seems to determine a peculiar alterative effect in the subjacent textures.

At one time the arsenical preparations were in great repute as external applications, but the serious consequences which often followed their employment in this mode have restricted their use. With proper precautions, however, they may be resorted to in certain cases with great advantage.

Arsenious acid appears to have been first used in 1524, by Fuschius, as a remedy for cancer; he applied a powder in which it was incorporated with soot and serpentary root[1]. In the course of a few days the whole of the ulcer was converted into a firm slough, after the separation of which a healthy sore was perceptible. But sometimes there supervened a state of fever, accompanied with rigors, vomiting, and fainting fits, which compelled a discontinuance of the remedy. As its utility in cancerous and other intractable affections is sustained by a strong mass of facts derived from experience, various attempts have been made to ascertain some plan of combining it, so as to counteract its noxious agency, but in vain. It has been stated, indeed, on very good authority, that arsenic is not absorbed from a cancerous surface, and that consequently its topical application is not liable to produce constitutional symptoms ; but the only sure way to avoid any risk of mischief is to dilute the poison as much as possible. The powder of Rousselot consists of two parts of arsenious acid, thirty-two of sulphuret of mercury, and sixteen of dragons' blood ; while the caustic *pommade* of Hellmund contains three quarters of a grain of arsenious acid in ten drachms and a half of the excipient. The latter formula has been successfully employed by MM. Heyfelder and Chelius, of Germany, in the treatment of superficial cancer and lupus. The following will be found a safe and convenient form for practical purposes : take of arsenious acid, finely comminuted, from four to six grains, of calomel one drachm and a half, of powdered gum arabic three drachms ; triturate these well together, and add as much distilled water as will form a soft paste. A layer of this, from a third to half a line thick, is to be applied to the surface of the sore, after the crusts have been removed, and it has been well cleaned by poultices. This produces but little pain, and separates spontaneously in eight or ten days. From two to six applications will generally suffice, for effecting the desired change in the organic actions of the part. By the use of a formula of this kind, various cases of bleeding fungus (not medullary fungus) are reported to have been cured. The author of the article " Arsenic," in the American Encyclopedia of Practical Medicine and Surgery, has recorded two such instances. In the one, the arm was confined in splints, and the arsenic freely applied ; here the recovery was complete : in the other, likewise fungoid disease of the arm, the patient has remained well for four years. Some other cases in corroboration of this point will be found in a late number of Gräfe and Walther's Journal. For further information concerning its employment in surgery, see the article " ARSENIC."

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[1] Poggendorff's Annalen. 1839. p. 609.

[2] Comptes Rendus de l'Institut. 1840.

[1] Loir. Des Ulcérations du Col de l'Utérus; Thèse de Concours. Paris, 1835. p. 29.

[2] Op. cit. p. 59.

NITRIC ACID produces immediate disorganization of the animal tissues ; but never penetrates deeper than a few lines, even when its action has been concentrated during twenty-four hours upon a diseased surface. The eschar is of a yellow colour, separating spontaneously in from fourteen to twenty days, but if poultices or unctuous dressings have been employed, in twelve days, or even sooner, provided the cauterization has been superficial. It may be advantageously resorted to in the case of diffuse nævus, warty excrescences, cancrum oris, and lupus. It exercises a powerful influence in controlling the progress of sloughing phagedena. In common with other corrosive acids I prefer applying it, by means of a pencil of amianthus, fastened to a glass rod with platinum wire.

SULPHURIC ACID is one of the most violent caustics known. In virtue apparently of its superior affinity for water, it corrodes, chars, and destroys the animal textures with great rapidity. It occasions considerable pain ; and the eschar, which is of an iron-gray aspect, semi-coriaceous, and of moderate thickness, separates much about the same time as that from nitric acid. It has been recommended by Rust for removing adventitious growths situated within the mouth and fauces. To prevent its spreading, he directs the addition of a little saffron, in the proportion of eight or twelve grains to two drachms of the strong acid[1]. It is well adapted for the cure of entropium. Professor Jüngken of Berlin, by whom I have seen it employed, applies it by means of a small wooden match. The patient being seated upon a chair, as in the operation for cataract, with his head fixed by an assistant standing behind, the operator endeavours to ascertain by repeatedly opening and closing the eyelid, that point in which the relaxation is greatest, and there applies the caustic, as there the cauterization is most efficient. Immediately below this spot the eyelid is to be covered with lint, so as to protect it against the acid, which is continually renewed, until a deep eschar is formed, whereby the outward integument is so much shortened, as to restore the eyelid to its natural position, and to withdraw the eyelashes from the bulb. The cauterization must be frequently repeated at short intervals, in order to prove of permanent benefit. Its effect is often momentary. After it is terminated, the eschar is to be wiped dry with lint, and left uncovered ; and the patient directed to draw the lid outwards several times in the day. The slough separates of its own accord ; meanwhile the healing of the ulcer proceeds, so that it is generally cicatrized by the time that comes away. Should the eyelid at this period still manifest some inclination to turn inwards, the cauterization must be renewed, but not until all trace of inflammation has subsided.

The sulphuric acid may be resorted to with benefit in the case of ulcerated condylomata.

HYDROCHLORIC ACID is an excellent application to obstinate ulcers of the cornea. I have used it for this purpose in the concentrated form, and also diluted with two parts of water. During the cauterization the eyelids should be held apart; and directly after, a little almond oil may be dropped upon the part; they should then be kept closed for a day or two, and covered with a light compress. The eschar produced by its contact with the skin is of an ash colour, hard and superficial, requiring the same time for its separation as that from the mineral acids, above-mentioned.

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[1] De Houpeville, De la Guérison du Cancer, p. 174.

[1] Op. cit. p. 266.

CAUTERIZATION. Lat. *Cauterizatio.*—By this is meant, the act of destroying a part of the living textures by caustics or heat.

In the article Caustics the operation of each substance has been fully described; and under the head of Burns copious information will be found concerning the accidental effects of fire. It remains for us now to point out the therapeutical effects of concentrated heat on the living textures, with its mode of employment.

As a general rule, cauterization may be performed upon any part of the body; but it is proper to avoid situations in the immediate vicinity of vital organs, of large nervous or vascular trunks, or of bone or tendon.

The employment of the cautery may be traced to a very early period in the healing art. Thus Hippocrates resorted to it, and after him the Arabian physicians, until the fifteenth century, when the chemical escharotics came into vogue and usurped its place. We are chiefly indebted to the continental surgeons, Percy, Larrey, Dubois, Klein, Rust, and Dupuytren, for having again invited attention to its value as a remedial agent.

Actual cauterization may be performed either by substances which impart their heat by direct contact or by radiation, as red-hot iron; or by substances which impart their heat during the process of combustion, as in moxa.

The action of the cautery is sudden, giving rise to a dry eschar, and considerable reaction in the surrounding parts. The resulting inflammation is of a sthenic character, and the suppuration is healthy. As a general rule, the slough does not extend beyond the site of application. Its effect in changing the vitality of neighbouring textures and of increasing the activity of their capillary circulation is much greater than in the case of the potential caustics.

The actual cautery, in virtue of its energetic, prompt, and penetrating action, has been resorted to in the instance of paralysis, rheumatism, muscular and tendinous relaxation; in virtue of its producing instantaneously a dry, firm, compact eschar, for arresting hemorrhage when other things fail, or from particular circumstances are inadmissible; as in cases of bleeding from an alveolar cavity, from the tongue, from the bite of a leech, or from an extensive parenchymatous surface. It is occasionally used after the excision of malignant growths, to destroy any remaining substance of a suspicious aspect, and also to remove portions of bone affected with caries, but is now seldom employed to render callous surfaces raw, prior to their re-union being attempted. Its use is contra-indicated in the instance of delicate individuals of high nervous susceptibility, and of children under four years of age, from the risk of excessive reaction. Previous to its being applied, the adjoining parts should be carefully protected against injury by means of pledgets of lint moistened with water, which the older surgeons called *defensives*.

To check bleeding, destroy morbid products, and the like, the part itself must be seared. But in diseases of the joints the cauterization must be executed in the vicinity; in palsy of the extremities, in the course of the spinal column; in trismus, over the nape and back; in prosopalgia, ptosis palpebrarum, and deafness, anterior to the mastoid process.

Of the various forms of searing iron, the conical, the flat-round, the button-shaped, and the three-sided prism will be found the most suitable in practice. The end of the shaft to which the head is attached is bent to a right or an obtuse angle, while the other end is firmly inserted into a wooden handle. The conical head of Percy's iron is one inch long, and eight lines in diameter at the base; his button-shaped iron is one inch in diameter and four lines in length: Rust's three-sided prismatic iron is sixteen lines long, each side is nine lines in breadth, the edges being truncated, and one of them directed upwards. For minute surfaces the stilet of a trocar, a knitting or sewing needle, may be employed.—The iron is raised to the desired temperature by means of a charcoal chafing-dish blown by bellows. The only dressing required after the operation is a simple linen compress, soaked in cold water.

The duration of contact will be more or less abiding, according to the indication which the surgeon intends to fulfil, and the situation of the part.

Thus, where we wish to determine a powerful irritation of the skin with little loss of substance, we may cauterize in the form of linear streaks, the *cautérisation transcurrente* of Percy, the *Streifenbildung* of German writers. These rays of fire, as they have been sometimes termed, which are made to run parallel and never crosswise, are from two to six inches in length, and from one and a half to three inches apart; their course being previously traced with some pigment. For their production it is directed that the operator, after receiving the prismatic iron from an assistant, should seize the handle with both hands and place the under edge of the cautery upon the remote end of the traced line, holding the back part of the edge a little apart from the skin, and then pass the iron with moderate rapidity along the whole length of the track. He must not allow it to sear too deeply, particularly on the first application, grasping it firmly lest it slip in its progress, and taking care not to fret the skin, should the anterior part have sunk too far into the surface. By following these precautions, four, or even more linear streaks may be produced at one time, using for each a fresh iron. In disease of the hip-joint the German surgeons recommend the formation of four or five streaks upon the buttock, behind the trochanter, parallel to the course of the sciatic nerves ; in disease of the shoulder-joint, four over the articulation ; in that of the knee-joint, one along each side of the patella ; and in that of the spine, one along the spinous processes. The same plan is had recourse to in neuralgia, palsy, and muscular relaxation.

In order to form an issue, the flat round iron may be applied to the spot for five or ten seconds, making it perform a slight rotary motion, to prevent the eschar from adhering to the metal. The small anterior surface of the prismatic iron will answer the same purpose. In cauterizing about the head, a practice recently recommended in hydrocephalus[1], parts covered with pericranium ought to be avoided, or at all events the iron should not be allowed to remain more than a couple of seconds.

To suppress hemorrhage we should touch the bleeding point with a conical instrument, at a white heat, for two seconds, withdrawing it immediately after by a movement of rotation. Poisoned wounds should be first freely dilated, and then energetically seared throughout their whole extent. Cancerous and other sores of a bad character, as hospital ulcer, must likewise be thoroughly seared. For other adventitious growths, as steatomata, polypi, and the like, it is sufficient to penetrate their centre with a trocar heated to whiteness —through warts and ranula a needle may be passed. In order to open the walls of an abscess, the cautery ought to be pressed steadily against the most prominent point of the surface—should one be inadequate, it must be followed by a second. Here a trocar stilet will be found very appropriate. (Encyclopädisches Wörterbuch der Med. Wiss. article *Cauterium.*)

It deserves attention that the actual cautery disorganizes more speedily and with less irritation and pain in proportion as its temperature is elevated. Hence the most active, the least irritant, and the least painful of all, is that at a white heat, while the most painful, the most irritant, and the least powerful, is that at a greyish or brownish red heat. The shade of colour which the heat has imparted to the cautery, is therefore of great importance, since it serves to indicate the thermometric pitch, and consequently the escharotic intensity.

The burnt surface may be treated in the first instance with cold applications. Should the inflammation run high, antiphlogistic measures will be proper. Touching the eschar, according to Mons. Larrey, with liquid ammonia, obviates inflammation, and the formation of matter. If the pain be excessive, and the subject very irritable, some anodyne may be given. Emollient poultices are to be substituted for the cold applications as soon as the slough begins to separate. In the instance of hemorrhage, the separation of the eschar is on no account to be accelerated ; hence it ought to be lightly covered with dry lint only, and frequently exposed to the air.

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(*Alexander Ure.*)

CAUTERY, (*καυτήριον*, from *καίω*, I burn,) any substance employed by the surgeon for the purpose of burning or disorganizing the living parts upon which it is applied. This object is attained in two ways : 1. Instantaneously by the direct application of metallic instruments heated to a red or white heat (the actual cautery). 2. By the application of caustic substances, such as the concentrated acids, or pure alkalis, which act upon the living tissues much in the same way as the concentrated caloric itself, but much more slowly (the potential cautery). Among this class of substances, some are very active, and are called *Escharotics*, others mild, and are denominated *Catheretics*. See Caustics.

CEPHALHÆMATOMA. (From *κεφαλὴ*, the head, and *αἱμάτωμα*, a bloody tumour.) This word, which, as appears from its derivation literally, means any collection of blood about the head, was introduced by Naegele[1] in 1822 as a convenient name for the affection commonly known as the "cranial blood-swelling of new-born infants," and to this it has since been restricted. The tumour thus designated is caused by an extravasation of pure blood, and herein, as in almost all its other characters, differs from the ordinary scalp swellings occurring after laborious labour (the *œdème sero-sanguin* of the French, and *caput succedaneum* of the German writers) ; in the latter the effused, or rather infiltrated, fluids are in great part serous.

Cephalhæmatoma is not of such modern discovery as the novelty of its study would lead us to suppose. Certain passages in the writings of early authors show that it had been noticed, and that attempts had been made to establish its diagnosis some centuries since [1]. Our countryman Gooch [2] appears to have been among the first, however, to give a general description of these tumours; twenty years later the elder Osiander drew attention to them in his own country, but, like Gooch, exhibited very imperfect acquaintance with their nature; and from the appearance of a paper by Michaelis in 1799, may be dated the really careful investigation of which they have been made the subject. Our object in the following pages will be to describe succinctly the results of these investigations, and to exhibit in the present diversity of opinion on some important points, the ample field still left for accurate enquiry.

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[1] Hufeland's Journal, April, 1840.

[1] Vide Keller's Thesis.

According to the observations of different authors, effusions of pure blood may occur at the period of birth, either outside, within, or in the substance of the cranial bones; admitting these observations to be correct we should have an *extra-cranial*, an *intra-cranial*, and an *interstitial* variety of the affection.

§ 1. EXTRA-CRANIAL CEPHALHÆMATOMA.

The effused blood may in this variety be contained between the pericranium and bone (sub-pericranial c. Valleix); or be external to that membrane (extra-pericranial c.)

(*a.*) *Sub-pericranial.*—(SYN. Abscessus capitis sanguineus recens natorum [Palletta, Dieffenbach]. Ecchymoma capitis neonat. [Carus Brandan]. Ecchymoma capitis neonat. cariosum [Plank]. Ecchymosis capitis [Osiander]. Thrombus neonatorum [Gölis, Dugés].) The majority of writers point out the second and third days after birth as the period within which the formation of these tumours commences, and such is very frequently, but not invariably the fact. Osiander affirmed long since that the tumour may be occasionally detected before the rupture of the membranes. Stien saw it developed one or two hours after labour, and Naegele has discovered it immediately after birth. The latter observer regards the pre-existence of the tumour to birth as incontestable, and ascribes its usual non-discovery till the second or third day to its previous small size. M. Fortin detected a cephalhæmatoma as large as a pigeon's egg on the left parietal before the termination of labour. Of fifty-three cephalhæmatomata observed by Burchard there were discovered—

Before labour	2
During, or shortly after do.	24
The 2nd day after do.	4
The 3rd	15
The 4th, 5th, 6th, 7th, 10th, and 11th, each one	6
Day not noted	2

The presumed tardy appearance of the tumour may in some of these cases have depended on careless examination of the head, but this cannot have been the fact in one instance of co-existence of three cephalhæmatomata; of these one was discovered on the right parietal immediately after birth, a second appeared on the third, and the last on the fifth day.

The most usual *seat* of this affection is the posterior and superior part of the right parietal; but that it occurs on other parts of the skull, especially on the corresponding bone of the left side, the following table, in which the seat of sixty tumours (fifty-three, Burchard; seven, Valleix) is noted, fully shows.

Right parietal	34 times
Left do.	20
Occipital	3
Frontal	1
Parietals, but not accurately described	2
	60

It is highly probable, however, as M. Valleix observes, that in consequence of the tenacity with which the pericardium adheres to the sutures, effused blood cannot spread from one side of the cranium to the other, and hence that cephalhæmatomata described as seated on both parietals, and unseparated by the sagittal suture, cannot have belonged to the variety now under consideration. Unger affirms he has seen a cephalhæmatoma on the mastoid portion of the temporal bone.

Though usually single, several of these tumours sometimes co-exist in the same skull, as the experience of Burchard and Valleix shows. In forty-four infants there was one swelling; in five there were two; in two three were discovered. Similar facts have also been noticed by Michaelis, Paletta, Naegele, Zeller, Krans, Hüter, and others.

Their *size* is influenced by their exact seat, the mode of treatment to which they are subjected, and the general health of the infant: they have been seen as small as nuts, and so large as to cover the entire parietal bone. Their *form*, too, according to the observations of Burchard, depends on their position. Those on the parietals affect an oval shape, they are confined to the upper part of that bone, and very rarely extend over the parietal protuberance (Burchard says *never*, but the experience of Valleix, among others, is at variance with this statement); in some instances the sort of sinus caused in the outline of the tumour by the absence of swelling in the latter position, gives the whole a reniform shape, or that of a cornucopia. The absence of effusion over the protuberance depends on the close adhesion of the pericranium in this situation. Tumours seated on the occipital and frontal bones are commonly rounded.

The superjacent integuments are commonly said to present their natural colour: Feiler and Osiander [1] maintain the contrary; the latter even founded on the livid red tinge of the skin in this affection a ground of distinction from common caput succedaneum. Dr. Burchard's experience on this point is as follows :—

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[1] *Ætius*, Libror. Medicinal. lib. vi. init. t. i. fol. 99, ed. Venet. 1534. *B. Valentin.* Ephemerid. Nat. Curios. Dec. II. Ann. II. Obs. 162, 1683.

[2] A Practical Treatise on Wounds, vol. i. p. 322; Norwich, 1767.

[1] Handb. der Entbindingskunst. bd. II. § 268. Tubingen, 1830.

Colour whitish, skin attenuated and transparent	in 5 cases.
Scarlet red	2
Violet, blackish, and livid	7
Perfectly natural.................	24
Not observed	7

A yellow tinge sometimes remains, according to the same observer, for some time on the skin after the total disappearance of swelling. In fifty-one of the tumours observed by him the temperature of the investing skin was as nearly as possible the same as that of the rest of the body : one of those on the occipital bone was, it would appear, hotter than the rest of the surface ; in another instance elevation of temperature was ascribed to the treatment by the potential cautery.

When fully developed the tumour is tense, does not pit on pressure, and is the seat of distinct or obscure fluctuation. According to M. Valleix it is always possible, even when the swelling is extremely tense, to touch the subjacent bone within the confines of the swelling, by first placing the finger on the edge of the latter and then pressing gradually inwards towards the centre. Strong pressure does not in any case produce either diminution in the size of the tumour, convulsions or other cerebral symptoms ; nor does the infant give any evidence of suffering pain, while it is handled. It is immoveable.

Naegele affirms that he detected pulsation twice in these tumours ; Höre looks upon this as a usual phenomenon ; but the vast majority of observers having altogether failed in satisfying themselves of its existence, doubts of its ever occurring began to be entertained. Recently, however, Dr. Burchard has announced his having, in company with several persons, discovered pulsation in two cases. In both of these instances an intra-cranial cephalhæmatoma co-existed with the sub-pericranial, and a wide perforation of the bone formed a free communication between the two collections of blood. Dr. Burchard is inclined to believe on the evidence of these cases that pulsation is indicative of the co-existence of these two varieties of blood-swelling, an opinion which renders intelligible both the mechanism by which it is produced and the rarity with which it has been observed. He has not stated whether the pulsation was synchronous with that of the arteries ; but remarks that it was more distinctly felt when the infant cried out.

Among the most important signs of these tumours is a hard, elevated, rough, in some cases denticulated prominence surrounding them wholly or partially at the base,—whence the impression of a deficiency of the cranium immediately within the circumference of the swelling is conveyed to the finger on examination. The constant existence of this prominence has been made a subject of warm dispute. Michaelis contended that it is present from the commencement of the growth of the tumour and pathognomonic of it,—an opinion which, as we shall presently see, is a necessary consequence of his theory respecting the nature of the disease. On the other hand Naegele, Zeller, and Höre, whose narrations are marked by care and precision, make no mention of this prominence as occurring at the outset of the formation of the tumour ; and Naegele refers to a certain number of borrowed cases (in those observed by himself it always existed) in order to prove that even when in its stage of full development, the character in question is not invariably discoverable. Stein affirmed that it is often absent, and Busch, denying its presence *in toto*, regards those who describe it as labouring under an "optical illusion." This discrepancy of opinion has been well and simply accounted for by M. Valleix. In an infant examined about twenty-four hours after the first detection of a tumour on the head, this observer found a cephalhæmatoma possessing all the usual characters except the prominent rim. The following day the tumour had increased in size, and a prominence of about a line high and a line and a half broad was now detected corresponding to the lower and anterior borders of the parietal bone. Zeller himself relates (though the importance of the fact escaped him) that Wigand, having watched the growth of two cephalhæmatomata for a day, ascertained that at the end of that time only did the prominence begin to form. In M. Fortin's, already referred to, it was not to be found at birth, but was distinctly perceptible two days after. Wokurka, in alluding to Stein's opinion that the bony ridge is often wanting, asserts, like Valleix, that this is only true of tumours examined almost immediately after formation. Again, in some of the cases adduced to prove the absence of this elevated rim, the tumour had been opened by incision immediately on its appearance, and its further evolution thereby interfered with. In fine its production seems a constant occurrence when time is allowed for the process.

Palletta believed that these tumours go on increasing in size indefinitely unless opened by the surgeon, a notion of which general experience has proved the inaccuracy. Far from this, they sometimes acquire their full size in a few hours. According to M. Valleix it is not uncommon to find them increase for a day or two ; after the formation of the elevated margin, they undergo no change until they commence to diminish in bulk. Burchard describes three distinct phases ;—that of growth, which lasts seven days ; that of quiescence, from seven to twenty-one ; of decrease, which is not complete till the seventh or ninth week.

Anatomical characters.— Before describing these, it will be well briefly to notice the condition of the bones of the cranium at the period of life to which the affection is peculiar. The pericranium in new-born infants adheres very slightly to the bones, except in the immediate vicinity of the sutures and fontanelles ; and the interspace between this membrane and the osseous surface, except over the protuberances, is filled with cellular tissue of soft, reddish, and almost mucous appearance, in which a multitude of vessels ramify after emerging from the bones. The arrangement of the fibres of the latter is distinctly radiated, a fact traced by Haller to the mode in which the vessels diverge from the centre of ossification to the periphery of the bone. Thus constituted, the bones form a spongy substance, saturated with blood, in such manner, that if either face be pressed upon after the removal of their investing membranes, blood oozes forth from the other;—so free is the communication, that if water be forcibly injected by the aorta or carotid, this pours forth in abundance on the external surface, provided the pericranium have been removed. In examining this point M. Valleix affirms he ascertained "that the internal table of the cranial bones is formed *first;* that numerous vessels, ramifying on its surface, and constituting a rudimentary diploe, *next* deposit a multitude of osseous fibres, and, *finally*, that at a later period a layer of compact tissue—the external table—is produced; thus there are three distinct stages in cranial ossification. At birth the parietal prominences alone, traversed as they are by the majority of the nutritious vessels, have reached the final stage. And it is not a little remarkable, that those very parts of the bone, when at a later period both tables unite into one, and all trace of diploe is lost, are the only ones that at birth consist of two distinct tables separated by true diploe. For the first fifteen days of life, or in many instances for a much longer time, the bones reach the second stage only of ossification, except at the parietal prominences: they have a well-formed internal table, and a vascular diploe, but no external table." The easy expressibility of blood from the cranial bones at birth may be ascertained; respecting the absence of the external table we cannot altogether coincide with this author. In the skulls we have examined for the purpose, by section and otherwise, both tables were distinctly visible; nevertheless the spongy tissue was sufficiently exposed between the radiated fibres of the external table, to justify us in regarding this in a very imperfect state of development.

We may now consider the state of these parts in infants affected with cephalhæmatoma. The condition of the integuments has already been described. M. Valleix always found the fascia in the natural state. The pericranium, though invariably thickened, is said by this observer to retain its usual semi-transparency, and presents a smooth polished surface, resembling that of a serous membrane, on the side next the effused blood. In some instances observed by Chelius and others, it appears to have been partially ossified; it adheres firmly to the upper edge and outer surface of the elevated rim already alluded to, so firmly, that occasionally (Burchard) the latter may be torn away in part during the removal of the former. Outside the upper edge of the elevated rim, the inner surface of the pericranium presents the natural rough appearance from adhering shreds of cellular tissue, as well as its other normal properties.

Connected with the internal surface of the pericranium, and between it and the effused blood, is found an adventitious membrane, which, by careful dissection, may be traced over the surface of the bone, and found to form a sort of capsular investment for the blood. The aspect of this membrane varies from that of a merely gelatinous matter to that of condensed cellular or serous tissue, resembling precisely, when of the latter species, the pseudo-serous membrane produced round the blood in aneurismal sacs, and that effused into the cavity of the arachnoid, for example, as shown by Bizot[1] and Bondet[2].

The condition of the portion of bone underneath the tumour has been very differently described by different authors. Michaelis was of opinion that the effusion is always connected with caries of the bone, whereby the outer table is destroyed within the limits of the tumour, and the diploe laid bare. Palletta also maintained that a "certain part of the external table of the cranium is deficient," but does not express any distinct opinion upon the cause of such deficiency. Naegele and Zeller, on the other hand, affirm that unless the discharge of the contents of the tumour be delayed till a very late period, the bone is found to be *healthy;* and in proof of the fact adduces several cases in which, after incision of the tumour, the surface of the subjacent bone was felt to be smooth and polished. The notion of Michaelis and Palletta cannot be maintained; the latter seems, indeed, to have refuted himself by describing a white gelatinous membrane on the surface of the bone; for, as M. Valleix has remarked, such an appearance is never observed on carious or necrosed surfaces. According to this pathologist, the bone, if the tumour be opened early, is found in the condition already described as appertaining to health; if at an advanced period, the surface is rendered rough by the progress of ossification of the external table. The smooth and polished feel described by Naegele, he plausibly refers to the adventitious membrane already spoken of: the meaning of the term healthy, as used in the present instance by these two observers, of course widely varies.

Burchard, on the other hand, maintains that the bone is invariably diseased; and there can be no doubt that in five out of nine cases examined by him after death, there was either rounded perforation or fissure of the bone; and although the precise period of occurrence and mechanism of this perforation has not yet been ascertained, it seems probable that a diseased condition of the bone, whether preceding or following the effusion of blood, must have something to do with it: Burchard himself suggests that it may have been in his cases, as often occurs in the situation of the parietal bones, an abnormal congenital foramen, known in Germany as Osiander's fontanelles. These cases are, however, exceptional ones, nor can any general inference respecting the state of the bone, where no perforation has occurred, be drawn from them. Burchard further states his having ascertained by microscopical examination, conducted with Prof. Perkinjé, that the medullary canaliculi of the bone are dilated, and the osseous fibrils swollen.

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[1] Mém. de la Soc. Méd. d'Observation, t. i.

[2] Mémoire sur l'Hémorrhagie des Méninges, 1839.

The state of the *internal* surface of the bone requires more examination than has yet been given it. Burchard says it presents an abnormal aspect,—that it is even in some instances destroyed; M. Valleix, that it is invariably healthy: the former most probably refers to cases of co-existing internal cephalhæmatoma; the latter seems to express an *à priori* opinion.

The sensation of an elevated and hardened rim, experienced in examining the edges of these tumours, and supposed by Michaelis to be caused by the deficiency of the external table, is found to be produced by a distinct bony ridge, of adventitious growth, in the majority of cases surrounding the entire of the effusion; in others, wanting in the vicinity of the sutures. This production is evidently unconnected with the subjacent bone as respects its cause,—in other words, is not a mere thickening of some portion of this, for it may be easily detached therefrom either with the finger or a scalpel, and the bone is found to exhibit its natural convexity underneath. Its vertical section is triangular; its inner face generally perpendicular to the surface of the cranium, the external sloped off; its height, varying in different points, rarely exceeds a line and a half (Fr.), and its dimensions are not proportional to the bulk of the swelling. Its structure varies, but it seems usually to be composed of a friable material, produced by the union of osseous granules and a reddish liquid, covered with a thin stratum of compact substance. It does not cause any *visible* elevation of the border of the tumour before the removal of the integuments. This description is borrowed from the work of M. Valleix.

M. Valleix never discovered any læsion in the vascular system of the skull outside the limits of the effusion, and was informed by Dieffenbach that he had frequently injected the vessels in indubitable cases of cephalhæmatoma without finding them torn. Dr. Burchard asserts that they always present a peculiar morbid aspect proper to the affection; this, however, he has not attempted to describe.

The contents of the tumour vary in quantity and quality. It has been found to contain so little as a scruple, and so much as upwards of seven ounces of blood. The latter is either fluid, coagulated, or "gelatino-fibrous," as observed by Burchard, who ascertained that, as might have been expected, its condition depended on the length of time it had been effused. When an incision was practised early, florid, arterial-looking blood escaped, and a new accumulation, of which the materials sometimes coagulated in twenty-four hours, followed: the viscidity of the fluid was proportional to the tardiness of incision. In the cases examined after death the blood was described to have been in great part absorbed, and the remainder reduced to a plastic gelatinous mass, or transformed into "*bony*" substance. The fluid is inodorous.

We have seen that sub-pericranial may be complicated with intra-cranial cephalhæmatoma; and it is not very uncommon to find scalp swellings (sero-sanguineous œdema) co-existing with it. Twelve of Burchard's forty-five patients presented this combination; in two instances the œdematous swelling was double, in nine seated on the same parietal as the cephalhæmatoma, in five on the opposite one; in several cases the effusion of blood did not take place until the œdema had disappeared, in some both occurred simultaneously.

The contradictory opinions held on the anatomical condition of the parts in this affection leads us to expect anything but harmony on the subject, or its causes and mechanism. Numerous observers contend that it is caused by violence directly applied to the part during protracted labour, either from impaction (Feiler), or pressure against the sides of the pelvis (C. C. Klein); or from contusion with the forceps, &c. (F. B. Osiander.) But these practitioners, and others who have adopted very similar notions, have doubtless confounded the affection, which we now describe, with common œdematous scalp-swellings; for accurate observation has proved that it occurs most frequently after easy labour, during which the head has not undergone any notable pressure. Not a single one of Naegele's cases occurred after laborious parturition; Meissner, Hüter, and Valleix have observed it in infants extracted by the feet; it has been found in the second born of twins presenting the breech; and we have seen how frequently its existence has been ascertained before or immediately after the rupture of the membranes. Hence the opinion referring the affection to severe pressure or contusion is untenable. Michaelis ascribes the effusion to the exposure of the diploe resulting from the carious destruction of the external table; of this opinion we have already seen the error. Naegele vaguely refers the rupture of vessels to abnormal development of the bone; Meissner and Neumann to displacement or riding of the bones of the scalp during labour; Brandau to a congenital relaxed state of the vessels of the head; Stein fancies the disease produced by an abnormal disposition of the vessels; Siebold by a state of the vascular system of the bone analogous to the aneurism by anastomosis of the soft parts. All these notions are either clearly shown to be incorrect by the previous description, or at the best insignificant and hypothetical. Busch having observed a large blood-tumour on the occiput of a child delivered with the forceps, which communicated with the sinuses, deduced a general theory of the disease from this example of a totally different affection[1].

Dzondi believes the proximate cause of the affection to consist in imperfect development of a part of the parietal bone, the diploe of which is *at the time of birth uncovered by an external table.* The delicate vessels of the diploe are burst, he supposes, by the forcible rush of blood to the head, consequent on the action of the uterus, or of pressure against the sides of the pelvis. The imperfect development of the bone in the affected part he attributes to the continuous pressure of the promontory of the sacrum on the head, and especially on either parietal bone.

M. Paul Dubois considers that from the extreme facility with which blood may be expressed from the infant cranium after the separation of its investing membranes, such separation, if it occur during life, must lead to the formation of cephalhæmatoma, and hence that the causes of the former are the true problem. These, he maintains, may be of various kinds, either, for example, unnaturally lax union of the pericranium and bone, violence down to the head, or disease of the osseous tissue itself.

In examining the skulls of new-born infants, M. Valleix was struck with the almost invariable appearance of an ecchymosis between the bones and pericranium of the upper part of the head, commonly most extensive on the right parietal: the cellular tissue in which the infiltration of blood existed, was usually fragile, thickened, and granular, in some rare cases ruptured, and in consequence of this, blood effused in a thin layer. Judging from its oval form, as well as from its precise situation on the skull, that it could not be produced by pressure against a resisting surface, such as the walls of the pelvis, this observer infers that it arises from circular constriction in the centre of the passages, and that the agent of this constriction must be the neck of the uterus. The usual greater size of the ecchymosis on the right parietal, he attempts to explain by the fact that when the head is at the inlet, the chin is turned towards either shoulder, and a certain degree of obliquity thus given to the position of the head, which causes one of its sides to present before the other; now it is well known that the right parietal is that which most usually passes the cervix first. Such being the mode of origin of the ecchymosis, that of cephalhæmatoma must, according to this author, be admitted to be the same, only occurring in a more intense form; because the gradual passage is traceable, in different heads, from simple red tint of the part to evident infiltration of blood, destruction of tissue with effusion, and finally tuberiform accumulation of the same fluid, or true cephalhæmatoma. This theory cannot be said to be shaken by the occurrence of the tumour in cases of "easy labour," but it is difficult to understand how the cervix can have exercised material pressure on the skull of the second born of twins, extracted by the feet, or before the rupture of the membranes; and yet, as we have seen, the tumour has been discovered under both these circumstances by competent observers. Again, according to this theory, the pre-disposing and exciting causes of the effusion are present in every infant at birth, yet, as we shall show from statistical documents, scarcely more than one in a hundred infants are subjects of the affection: M. Valleix urges, in reply, that its incipient stage is incomparably more frequent, and that the most favourable cases for the production of the tumour are those in which a large portion of the parietal presents at the cervix, an occurrence which is sufficiently rare. But on the other hand, as the reader will perceive, were M. Valleix's doctrine correct, the tumour should always exist on the parietal bone first extruded through the cervix uteri; now the following facts from Dr. Burchard's practice, which are rendered particularly valuable from their not having been stated in reference to any theory, show that this is far from being the case. In twenty of his cases of vertex presentation, the cephalhæmatoma existed on the parietal next the symphysis pubis; in fifteen, on the contrary, the swelling was seated not on the presenting parietal, but on that next the promontory of the sacrum.

On the whole it appears that the effusion mediately depends on imperfect development of the external table of the bones, and lax adhesion of the pericranium; immediately upon any causes affecting a separation between the latter and the bony surface of these, circular constriction of the cervix uteri is probably the most frequent, but certainly not the sole, as indeed M. Valleix himself allows may be the fact. Respecting the state of the bone itself and the influence of this on the effusion, it will be observed that there is the evidence of these authors in favour of the absence of the external table; that of Michaelis, who conceives it due to local caries; of Dzondi, who ascribes it to local abnormal suspension of development from pressure; of Valleix, who maintains such imperfection the natural condition at this period of existence. That it is wanting in, at least, some cases of cephalhæmatoma is more than probable, but this may be accounted for in various ways; it is not impossible that in cases pre-existing to birth the collection of blood may have really formed in diploe and destroyed the ill-formed outer table by pressure; were this the fact, subpericranial would be only an advanced stage of interstitial cephalhæmatoma.

Dr. Burchard examined certain particulars in the condition of the mothers of his patients: they were of various ages, as the following table shows :—

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[1] A case closely similar to that of Busch has been related by Flint, New England Journal of Medicine, vol. ix. p. 112. 1820.

9	were from æt.	16	to	20
22		20	...	25
4		25	...	30
2		30	...	35
5		40	...	45
3		age not stated.		

Twenty-nine of these women were confined for the first time, eight for the second, four for the third, eighth, twelfth, and fourteenth times. This prevalence of primiparous women among the mothers of cephalhæmatomatous children, a circumstance already noticed by Busch, d'Outrepont, and E. von Siebold, would be of consequence, were it not that the Lying-in-Hospital at Breslau, where Burchard observed, is chiefly devoted to the reception of women pregnant with their first child.

The comparatively greater frequency of the affection in male infants is exceedingly remarkable : of forty-three of Dr. Burchard's patients thirty-four are boys, nine girls. Twenty of these came into the world in perfect health ; sixteen were either born, or soon after became affected, with "icterus neonatorum ;" two had several attacks of cerebral congestion before the tumour was opened, &c.

Diagnosis.—Among the affections for which this form of cephalhæmatoma is liable to be mistaken is congenital encephalocele. The points of distinction between them are nevertheless, as may be gathered from the subjoined enumeration, numerous and clearly defined.

Sub-pericranical Cephalhæmatoma.	*Hernia of the Brain.*
Is the seat of fluctuation.	There is no fluctuation, unless water be contained in the hernia.
Is perfectly indolent.	Is occasionally the seat of pain, especially under pressure.
Pressure produces no cerebral symptoms.	When large, cerebral symptoms frequently arise spontaneously ; these are greatly increased by pressure.
Nor does it change the size of the swelling.	Pressure diminishes its bulk, which it reacquires when the pressure is removed.
The investing skin and hair are in the natural state.	The skin is thinner than natural, and without hair.
Is never seated on the sutures.	In the vast majority of cases is seated on the sutures or fontanels.
Is tense and hard.	Is elastic and soft.
Pulsation is extremely rare.	Pulsation is an ordinary symptom.
Is uninfluenced by the respiratory movements.	Swells during expiration, and sinks during inspiration.
Apparent perforation, caused by the elevated bony ridge.	Real opening in the skull, either between the sutures or through the substance of the bones.
Is never pedunculated.	Inclines to the pedunculated shape, which is often very marked.

It seems hardly possible to confound this affection with ordinary hydrocephalus ; a subfascial aqueous cyst, spoken of in Zeller's Thesis, might be distinguished by the absence of the bony elevated rim. Erectile tumours of the scalp are soft, spongy, easily depressible, lessened in size by pressure, recovering their former dimensions by successive influxes of blood, expand when the infant cries or coughs, are of a bluish-violet tint, have no prominent elevated border, and are not the seat of fluctuation ;—the characters of cephalhæmatoma are in all respects the reverse.—Encysted tumours of the scalp are distinguishable by their being moveable, and by the absence of the elevated margin. Perforating cancer of the meninges is reducible, is not surrounded with a raised rim, and is otherwise specially characterised. (See Cancer.) Collections of pus under the pericranium, which may possess almost every external character of cephalhæmatoma, even to the presence of an elevated and indurated margin, M. Valleix presumes might be distinguished therefrom by the slow and gradual formation of the tumour, the pain in the part (?), and tenderness on pressure, as well as inferior degree of hardness of the surrounding prominence, which, it appears, contains no osseous matter, and is composed of hardened cellular tissue.—Common scalp swellings are characterised by being almost invariably the result of difficult labour, by being seated on the part descending first into the cavity of the pelvis, by being always single, indistinctly circumscribed, of deep livid colour, non-fluctuating, pitting on pressure, rarely surrounded by an annular prominence, and disappearing in from twelve to forty-eight hours. The distinctive marks of extra-pericranial cephalhæmatoma will be presently stated. M. P. Dubois once met a combination of œdematous scalp swelling, extra and sub-pericranial cephalhæmatoma ; under such circumstances an accurate diagnosis must be next to impossible.

Termination.—In favourable cases, when the disease has been left to nature, or simply treated by discutient applications, the effused blood is slowly absorbed[1], and the process of ossification proceeds from the bony eminence to the centre of the base : the period required for its completion varies, forty days do not suffice for the purpose, as it appears from an observation by M. Valleix. Even after the lapse of many months the site of the tumour may be determined by the state of the bone : in an infant who died at the age of twelve months, of chronic hydrocephalus, Dr. Burchard found a sort of prominent cicatrix of the bone marking the limits of the original tumour ; the corresponding diploe was thickened, soft, and gorged with blood. In a case examined two years after birth, the parietal bone was somewhat more convex than its fellow ; in an infant aged three years, Becker found the bone irregularly depressed and elevated.

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[1] M. Gaussail has reported a singular case, in which the disappearance of a cephalhæmatoma coexisted with attacks of epistaxis.

In unfavourable cases the tumour occasionally inflames and suppurates; but even under these circumstances the infant, if otherwise healthy, may recover perfectly. In other instances the pressure of the blood excites disease of the bone. Naegele relates the case of an infant in whom the incision of the tumour gave issue to a considerable quantity of pus and blood. Sixteen weeks after this, a lamella of bone came away; and the patient dying with diarrhœa, a perforation an inch and a half in diameter appeared in the affected parietal. Kopp has known perforation followed by death; and Osiander considers caries of the bone with gangrene of the integuments the natural effects of the effusion, if left to itself, and the forerunners of death. The experience of others proves this to be an exaggerated estimate of its danger.

The opinions of writers on the *prognosis* of this affection vary. Michaelis pronounces it generally of most dangerous nature; an opinion explained by his theory of its causes. Golis maintains that, left to itself, it is exempt from danger, but that incision and evacuation of its contents not unfrequently compromise the life of the patient; while Höre thinks that it invariably terminates rapidly and favourably, *provided* these very same measures be pursued[1]. Such of M. Valleix's patients as died, perished of intestinal disorders unconnected with the effusion. Of Dr. Burchard's forty-five patients, twelve died at periods varying from thirty-six hours to three years after birth; six of these during the first three weeks of life, of whom four died with trismus or tetanus, (a fact which will be presently explained,) two in a state of marasmus: five of the other six fell victims to chronic hydrocephalus.

There can be little doubt that the contradictory character of these opinions originates in some measure in imperfect acquaintance with the diagnosis of the disease. Besides the presence of intra-cranial cephalhæmatoma materially influences the event,—in five of seven subjects who died within nine weeks after birth and were examined by Dr. Burchard, intra-cranial co-existed with the external effusion.

A circumstance which has contributed to involve this subject in obscurity is the rarity of the affection; respecting its precise frequency however there is considerable difference of opinion. Naegele met with seventeen cases only in the course of twenty years' extensive practice. M. Baron, physician to the Foundling Hospital at Paris, believes that it occurs once in about 500 births, and the experience of M. Valleix at the same institution is to a similar effect. Höre infers from his own observations that one in every hundred infants labours under it; Strewe examined 250 infants born at the Berlin Hospital, without detecting it once; Boepp calculates that it occurs once in every 150 births at the St. Petersburg Foundling Hospital; Dr. Burchard discovered it in $\frac{1}{108}$ of the infants born at the Breslau Lying-in Hospital, while the subjoined calculations given by this author prove the variable frequency with which it exhibits itself in some other German towns:—

Towns.	No. of years.	Births.	Cases.
Dresden	8	1972	6
Würzburg ...	13	1992	2
Marburg......	7	910	4
Berlin.........	8	1314	5

Whence we have 17 cases in 6188 births, or 1 in 364. Moschuer and Kurzak affirm that the disease did not present itself in a single one of 18,292 infants born from 1789 to 1827 at the Prague Lying-in Hospital; but defective observation may here be very fairly suspected[1].

Treatment.—The use of discutient applications, incision of, or the promotion of suppuration in, the tumour, are the principal modes of treatment hitherto recommended.

The discutient, which must be regarded as little more than an expectant, treatment, has been on the whole the most commonly employed: infusions of aromatic plants, camphorated spirits of wine, hydrochlorate of ammonia, common salt, alum, &c. in solution, being the substances used for the purpose. Some writers consider this mode of treatment inapplicable when the tumour is of large size; others, as for example Gooch, recommend a trial of it under all circumstances, but are of opinion, "that when the resolvent treatment has produced no change after a reasonable time, it will then certainly be advisable to open the tumour, lest the fluid should be absorbed in a putrid state or the bone injured by it:" this time is fixed by Naegele at ten or twelve days. The decomposition of the fluid is, as we have seen, a groundless fear. M. Valleix adopts this practice, but upon different grounds; he does not apprehend putrid absorption or caries, but conceives that incision will facilitate the adhesion of the soft parts to the bone.

Moscati, Palletta, and Gölis, treated these tumours by exciting suppuration; the two former employing the seton for the purpose, the latter caustic potass. Although Gölis quotes thirty-two cases in favour of this mode of treatment, it has now no advocates; the relation of some of these cases is far from satisfactory, while its inventor himself admits it has sometimes produced fatal results, and on several occasions serious inconveniences.

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[1] The coexistence of intra-cranial effusion in Höre's cases may account for this opinion.

[1] The frequency of the affection in our own country remains to be decided. According to Goode not a week elapsed without the admission of a case of cranial blood swelling at the Foundling Hospital (at Norwich?); but common scalp swellings are doubtless included in this estimate. Underwood, falling into the opposite error (in which he is tacitly joined by his commentators), doubts that the affection ever occurs in England.

Incision of the swelling and evacuation of its contents have been very extensively practised. The time and manner of its performance are variously determined. Michaelis always operated immediately on the appearance of the tumour, a practice in which he was almost always followed by Von Siebold. We have mentioned the opinions of Gooch and Naegele in regard of this point; the former nevertheless acquaints us that the surgeons of the Foundling Hospital were in the habit of opening the swelling at once, if it exhibited no particular appearance of disease; they made an incision the whole length of the tumour, laid soft dry lint under the edges of the wound to facilitate the discharge of the extravasated blood, after having pressed out as much as they could without bruising the parts, and then applied a compress and easy bandage. Respecting the mode of opening the tumour, we find Klein and Carus contenting themselves with puncturing with a lancet, others incising the tumour from one border to the other, and Levert recommending a crucial division: a single incision of moderate size is decidedly the most advisable. Siebold recommends the scalp to be carefully shaved previously; F. B. Osiander, on the contrary, attaches much importance to the preservation of the hair on the tumour, believing that it strengthens and protects the wound: this is probably a point of little real consequence. Denudation of the bones of the skull, as M. Valleix remarks, is by no means dangerous in new-born infants; the extreme vitality of the parts preserves them from necrosis and exfoliation. Should, however, such separation of bone take place, and suppuration arise in the wound, these complications must be managed on ordinary principles. Simple as this operation is, it is not altogether devoid of danger: in two cases, one of them related by Smellie, the other by M. Valleix, death ensued from the division of some vessel or vessels of the scalp[1]. If troublesome hæmorrhage were thus produced, the bleeding vessels should be looked for in the lips of the incision and tied. The general pressure advisable for promoting the adhesion of the pericranium may be best effected by a close cap with a broad chin-band not too tightly applied.

Dr. Burchard's experience supplies a fair estimate of the comparative excellence of the different modes of treatment: with the exception, perhaps, of those opened with the knife, the tumours allowed to run their own course terminated most rapidly and favourably: unless where symptoms denoting cerebral compression arise in an infant labouring under cephalhæmatoma, the use of the knife should, as it appears to us, be altogether avoided.

(*b.*) *Extra-pericranial.*—Laborious parturition, rude application of the forceps &c. the ordinary causes of sero-sanguineous œdema, sometimes occasion rupture of one or more vessels of moderate calibre, and consequently accumulation of pure blood. The tumour thus formed is evidently from its seat and nature entitled to the name *cephalhœmatoma;* and as the effusion has been noticed both underneath and upon the fascia of the scalp, it is either *sub* or *super-aponeurotic.* As this tumour is the direct effect of violence, we need not here (see CONTUSION, HÆMATOMA) consider it otherwise than in respect of the diagnosis between it and the species already described. If the effusion be recognized immediately after birth, the distinction is, according to Naegele and P. Dubois, easily made; in fact, the extravasation under or upon the fascia almost always takes place together with or immediately after the appearance of common œdematous swelling; the evidences of difficult labour are visible in lividity of the skin, &c.; the tumour is painful and ill-circumscribed, for the blood is at first infiltrated through the areola of the cellular membrane, and not collected into a single mass. When the walls of these areola have been broken down by the pressure of the infiltrated fluid, the distinction becomes much more difficult; the blood then forms a tumour, more or less accurately circumscribed, fluctuating, and surrounded with an elevated border; these different characters are less marked, it is true, than in the sub-pericranial affection, but mere differences of degree will oftentimes not authorize a positive opinion. Should the effusion extend over a suture, the fair inference is, for the reason already stated, that it is not sub-pericranial.

§ 2. INTRA-CRANIAL CEPHALHÆMATOMA.

The symptoms of intra-cranial, super-meningeal (Valleix) or internal (Höre) cephalhæmatoma, in which the blood is effused between the dura mater and skull, are exemplified by the following case observed by Höre. An infant, born after a prompt and easy labour, remained after birth in a state of stupor, from which he was at first roused with great difficulty, and eventually could not be roused at all. The pupils were much dilated, the infant did not take the breast, and died comatose on the fourth day. A quantity of black coagulated blood appeared on the external surface of the right parietal bone, which was neither eroded nor discoloured, but the seat of a linear perforation or fissure extending almost entirely round the external collection of blood. The corresponding part of the dura mater was separated from the cranium by a bloody tumour, about the size of a pigeon's egg, producing marked depression and pultaceous softening of the adjacent brain. The bone was here very thin, its internal surface eroded and apparently even partially destroyed close to the sagittal suture. Hence it appears, as might have been expected, that the symptoms of this affection are those of compression of the brain.

Internal is almost invariably accompanied with sub-pericranial cephalhæmatoma; such was the fact in the above case, and in five instances observed by Dr. Burchard, and M. Baron has almost always noted the coexistence of an external tumour. Professor Moreau, however, as is stated by M. Dubois, has met with an example of uncomplicated supermeningeal effusion, whence it follows that this cannot be regarded as a mere effect or advanced stage of sub-pericranial cephalhæmatoma. The size and form of the opening in the bone, where such exists, are variable. In some instances it is a mere fissure of very limited extent; in others, as we have seen, it almost completely surrounds the external accumulation. In some cases the bone is perforated by a multitude of small openings like a sieve, or a single foramen of considerable size may be observed. In some cases the blood flows freely from one surface to the other through the perforation; such may probably, as already remarked, have been the fact in instances of external blood swelling, attended with pulsation. The corresponding part of the dura mater appears, according to the statement of Burchard, to be very closely connected with the bone at the periphery of the tumour, and through the medium of the same kind of adventitious ossiform matter, described as forming the prominent margin of the sub-pericranial swelling: the separation could not be effected without the help of a knife.

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[1] We have been recently informed by Professor Naegele that he once observed a similar case; this distinguished practitioner now leaves the affection wholly to nature, contenting himself with using some insignificant external applications.

Whether the perforation of the cranium is the result of imperfect development, disease, or traumatic lesion of the bone, or of the destructive action of an external effusion, cannot, from existing experience, be determined: related cases, however, show, according to their authors, that the two latter agencies have produced it.

Of the causes of this species of effusion nothing is known; unless in cases when it appears to be an effect of the sub-pericranial variety.

The prognosis is, under all circumstances, most unfavourable; communication with a sub-pericranial cephalhæmatoma, for reasons to be presently stated, in all probability lessens the gravity of the case. Of the fact of absorption of the effused blood ever occurring there is no proof at present; M. Velpeau suggests that it may become the origin of a "fungous tumour of the dura mater."

As there are no marks now known whereby the cerebral symptoms induced by this affection may be distinguished satisfactorily, it seems almost unnecessary to speak of its treatment; nevertheless, when such symptoms arise in an infant labouring under sub-pericranial cephalhæmatoma, they may be plausibly ascribed to complication with the intra-cranial variety. Now, in this case the practitioner should hasten to incise the external swelling, as, if it communicate at all freely with the internal, the contents of the latter may be evacuated, and the brain relieved of pressure (Valleix). The degree of fluidity of the contained fluid will affect the result of this proceeding, the utility of which has not been practically tested.

§ 3. INTERSTITIAL CEPHALHÆMATOMA?

A case in which the effused blood is alleged to have been contained between the two plates of the parietal bone, separating these in the manner of the walls of the frontal sinuses, is noticed by Burchard. But the description given of the parts connected with the tumour is unsatisfactory, and it is at least possible that the supposed external table may have been an ossified portion of pericranium. Further experience must be had upon this as upon almost all points in the anatomical history of the affection[1].

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[1] Dr. Geddings also, or Valleix, describes an effusion between the two lamellæ of the bone, but we have unfortunately been unable to procure his paper on the subject.

Kinder, in Med. Jahrb. des K. K. Oesterr. Staates, Bd. xiii.; or, Analekten über Kinderkrankheiten. Heft. viii. P. 30. 1836. *J. A. Burchard*, De Tumore Cranii recens natorum Sanguin. Symbolæ. 4to. Vratislaviæ, 1837. *Fortin*, Cephalæm. sous-péricranien, Presse Médicale, No. 9. 1837. *Gaussail*, Note sur un Céphalæmatome sous-péricr. que a disparu après une hémorrhagie nasale; Presse Médicale, No. 54. 1837. *Valleix*, Clinique des Maladies des Enfans nouveaux-nés, p. 494. Paris, 1838.

(*Walter Hayle Walshe.*)

CEPHALOMA. See Cancer.

CEPHALOMETER. An instrument no longer in use, which had been proposed for measuring the head of the fœtus during labour.

CEPHALOTOMY.—(From κεφαλὴ, the head, and τέμνειν, to cut.) Syn. *Cephalotomia*, Lat.; *Cephalatomie*, Fr.; Craniotomy. A term used in midwifery to express the removal of the brain—*excerebration?* of the head of a child impacted in the pelvis.

Any of the following conditions would, according to M. Velpeau, indicate the necessity of having recourse to this operation. 1st, When the fœtus is *dead*, and the passages are too narrow to admit of its being removed either by means of the forceps, or by turning; 2nd, when it is very probable that the infant has ceased to live, or is upon the point of death, and that, in order to remove it entire, it would be necessary to have recourse to the operation of hysteriotomy; 3rd, when the head alone remains in the pelvis, and the hand, the forceps, and the crotchets, have failed to extract it. It would be useless, dangerous, and should not be attempted, even when the fœtus is dead, if the small diameter of the pelvis is less than from eighteen to twenty lines[1]. A variety of instruments have been recommended by different obstetric writers for performing the operation of cephalotomy. Avicenna and Mauriceau employed and recommended a cutting tire-tête, somewhat similar in shape to the common crotchets. Levret, Dionis, Fried, and Ould, employed sheathed perforators. Simson has extolled the annular scalpel. The scissors of De la Motte, as improved by Denman and Smellie, has also been much recommended. The double crotchet of M. Baudelocque, cutting by its *concave* edge, and the cephalotomy scissors of Dugès have not, however, been much approved of by obstetric operators.

The steps of this operation are simple: the patient should be placed in the position required for the application of the forceps, and the rectum, but especially the bladder, being properly emptied, the fore-finger of one hand is to be placed on the head of the child, and with the other hand the perforator should be conveyed to the spot on which the finger rests. The instrument must be carried cautiously along the finger as a director, in order that the vagina and os uteri may not be injured. To make sure of not wounding the soft parts in the passage to the fœtal head, M. Velpeau recommends that the instrument should be sheathed with linen to within a few lines of its point, and the latter may be covered with a little ball of wax, as recommended by M. Baudelocque. When the vertex presents, a fontanelle or a suture may be chosen for the insertion of the perforator. Coutouly has, however, strongly insisted, that the center of that portion of the skull which presents is the proper place for the application of the perforator, and adds that a more solid point than the fontanelles should be chosen for that purpose; but this practice is not generally followed. If the os uteri is placed obliquely, as sometimes happens in cases of extreme deformity—it must, previously to having recourse to the instrument, be gently brought into the most favourable position. The perforator being placed on the head, the scalp is then to be pierced, and the point of the instrument rests on the bone through which it is to be pushed, either by a steady thrust or a boring motion. It is to be carried on till checked by the stops. The blades are then to be opened, so as to tear up the cranium; and in order to enlarge the opening, they may be closed and turned at right angles to their former position, and again opened so as to make a crucial aperture. Some have employed a trephine in place of a perforator. If the face presents, the perforator should enter the forehead just above the nose. If the child has been turned, the instrument must be introduced behind the ear, and the bones freely opened laterally and upwards. The crotchet is then to be introduced, and obtains a good fixture on the base of the occipital bone and foramen magnum[1]. Dugès recommends the cerebral debris, remaining after the operation, to be removed by injections of warm-water, conveyed into the cranium by means of a canula[2]: but Burns, on the other hand, thinks it hardly necessary to break down the brain, and states, that "if part of the cranium have entered the pelvis, some of the brain may come out with a squirt whenever the bones are opened, and at all times there is more or less hæmorrhage from the cerebral vessels." This author questions the propriety of allowing a considerable time to elapse, especially when the labour has been long protracted, after opening the head, before we apply the crotchet, as advised by many writers on obstetric surgery. Neither does he admit, with Dr. Osborn, that the specific number of *thirty* hours is sufficient to produce such a degree of putrefaction as materially to facilitate the operation. The chief benefit of delay is to bring as much of the cranium as possible into the pelvis. But in obtaining this desideratum we should not lose sight of the exhaustion, and even collapse, likely to happen to the mother from so long a continuance of the pains. When the deformity is slight, the uterine pains will suffice to expel the head after the perforator has been used. This, however, is a rare occurrence, for in the majority of those unhappy cases the basis of the skull remains either impacted in the pelvis or above its brim, until removed by artificial force. In all such instances the crotchet should be introduced through the opening in the cranium, and fixed upon the petrous bone, or such projection of the sphenoid bone, or occiput, as seems to afford a firm fixture, or on the outside of the base of the skull, at the pubis. The operator should then pull gently, to try the hold of the instrument, and if it be secure, he should draw in the direction of the axis of the brim by cautious and repeated efforts, exerting, at the same time, as much force as may be necessary to overcome the difficulty. As a safeguard to the soft parts, in case the instrument should slip, the operator should never omit to keep some of the fingers in the vagina and on the infant's cranium. If the force be cautiously and judiciously directed, he will in general feel the instrument slipping or tearing the bone before it finally gives way. In extracting the head, he should co-operate as much as possible with the pains. In performing the foregoing operation, the craniotomy forceps, now used, is considered safer than the pincers-shaped extractor, and preferable to the crotchet; one blade of this forceps goes within the bone and scalp, and the other without. Dr. Davis recommends a kind of bone-nippers, which he calls an *osteotomist;* with this instrument he says he has so broken the cranium as to bring it through a machine with an aperture of only one inch diameter.

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[1] Traité de l'Art des Accouchemens, vol. ii. p. 483.

[1] See Burns's Midwifery, ninth edition.

[2] Dictionnaire de Médecine et de Chirurgie Pratique, vol. v.

The force requisite to bring down the base of the skull, even when the pelvis is barely so small as to prevent the application of the forceps, is often much greater than is required in forceps cases. It is, therefore, a mistake to suppose that because the head is opened, the delivery must of necessity be easy. For further particulars relating to this operation, see the articles CROTCHET, PARTURITION, and PELVIS.

(Thomas H. Burgess.)

CERATES (cerata, from κηρὸς, wax). Compositions of wax, oil, or lard, with or without other ingredients.

Cerates take their name from the wax which enters into their composition, and to which they owe their consistence, being intermediate between that of plaisters and that of ointments: though no very definite rule for this consistence is either given or observed.

Cerates should be newly prepared or frequently renewed, as they are apt to turn rancid very soon, especially if there is much aërated water incorporated with them, as occurs, for instance, in the *Ceratum Galeni:* when rancid they acquire properties directly the opposite of those which belong to fresh cerates. Simple and fresh cerates, says M. GUERSENT, are soothing and emollient when applied to abraded surfaces. They produce an agreeably refreshing sensation when applied to burned or inflamed parts, and preserve ulcers and wounds from the contact of the atmosphere; they tend to assuage pain, and prevent irritating bodies from adhering to wounds, or other broken surfaces, and promote the cicatrization of suppurating sores, provided, however, that the diseased tissues are not too much relaxed; for then, like emollients, they increase the suppuration, and consequently retard the process of cicatrization. In such instances they would require to be tonic, or astringent.

Although simple cerates are in constant use in practical surgery, they are occasionally inconvenient, even when not rancid, in consequence of producing pustular eruptions, or erysipelatous inflammations, in individuals whose skins are peculiarly susceptible of irritation or of inflammation. In cases of this kind, the cerates should be replaced by simple mucilaginous decoctions.

The following are the cerates most frequently employed in this country, and those which are recognised by the London Pharmacopœia.

Simple cerate (ceratum simplex). Olive oil four fluid ounces, wax four ounces; add the oil to the melted wax, and mix them. Used as a cooling dressing, and as a basis for more active ingredients.

Cerate of calamine (ceratum calaminæ). Calamine and wax, of each half a pound, olive oil sixteen fluid ounces; mix the oil with the melted wax, then remove them from the fire, and when first they begin to thicken add the calamine, and stir constantly until they begin to cool. This is well known by the name of Turner's cerate, is used as a dressing to excoriations and ulcers, and to burns after the inflammation has subsided.

Cerate of cantharides (ceratum cantharidis). Cantharides, rubbed to very fine powder, one ounce, spermaceti cerate six ounces; having softened the cerate by heat, add the flies, and mix them together. Use: to promote the discharge from blistered surfaces; but as it is liable to occasion strangury, swelling of the lymphatics, general irritation, &c. in some individuals, the savine cerate is now pretty generally substituted for it.

Cerate of spermaceti (ceratum cetacei). Spermaceti two ounces, white wax eight ounces, olive oil a pint; add the oil to the spermaceti and wax melted together, and stir with a spatula until they cool.

This cerate is cooling and emollient, and is applied to excoriations, &c.; it may be used with advantage in all ulcers, where no stimulating substance can be applied, being extremely mild and unctuous.

Compound cerate of mercury (ceratum hydrargyri compositum). Stronger ointment of mercury, soap cerate, of each four ounces;

camphor one ounce; rub them well together. Use: to dispel indolent tumours.

Cerate of acetate of lead (ceratum plumbi acetatis). Acetate of lead, powdered, two drachms, white wax two ounces, olive oil eight fluid ounces; dissolve the wax in seven fluid ounces of the oil, then to these gradually add the acetate of lead, separately rubbed with the remainder of the oil, and stir with a spatula until they unite. Use: a cooling application in cases of burns and excoriations.

Compound cerate of lead (ceratum plumbi compositum). Solution of diacetate of lead eight fluid ounces, wax six ounces, olive oil half a pint, camphor half a drachm; mix the melted wax with eight fluid ounces of the oil, then remove them from the fire, and when first they begin to thicken, add gradually the solution of the diacetate of lead, and stir constantly with a spatula until cool; lastly, mix with these the camphor dissolved in the remainder of the oil. This is commonly called Goulard's cerate; is used for the same purpose as the foregoing. It has also been recommended in cases of chronic ophthalmia of the tarsus, and of the increased secretion of tears peculiar to old age.

Its virtues are cooling, desiccative, resolvent against chronic rheumatism, &c.; and is a proper application to superficial ulcers, which are inflamed.

Cerate of resin (ceratum resinæ). Resin and wax, of each one pound, olive oil sixteen fluid ounces; melt the resin and wax together with a slow fire, then add the oil, and press the cerate while hot through a linen cloth. Commonly called yellow basilicon; is used as an application to foul and indolent ulcers.

Cerate of savine (ceratum sabinæ). Bruised savine one pound, wax half a pound, lard two pounds; boil the savine in the lard and wax melted together, then press them through a linen cloth. Used in cases where cerate of cantharides excites too much irritation.

It was first described by Mr. Crowther, and has now been received into extensive use. A thick white layer forms daily on the part, which must be removed, in order that the cerate may be applied immediately to the surface from which the discharge is to be made.

Cerate of soap (ceratum saponis). Soap ten ounces, wax twelve ounces and a half, oxide of lead, powdered, fifteen ounces, olive oil a pint, vinegar a gallon; boil the vinegar with the oxide of lead over a slow fire, constantly stirring until they unite, then add the soap, and boil again in a similar manner until all the moisture is evaporated; lastly, mix with these the wax previously dissolved in oil. Cooling; resolvent; against scrofulous tumours, &c.: is a convenient application in fractures, and may be used as an external dressing for ulcers.

The following cerates are also used, though not so frequently as the foregoing,

Hemlock cerate (ceratum conii). Ointment of hemlock one pound, spermaceti two ounces, white wax three ounces—mix. One of the formulæ of St. Bartholomew's hospital, occasionally applied to cancerous, scrofulous, phagedenic, herpetic, and other inveterate sores.

Galen's cerate (ceratum Galeni). White wax four parts, oil of sweet almonds sixteen parts; when melted thoroughly add of water, or of rose water, twelve parts. The water should be added *guttatim* to the above when cool; and in order to incorporate it with the wax and oil, the preparation would require to be constantly stirred during the process. If too much water be added, it will separate from the cerate in the form of small drops. This is the cerate most commonly employed by the French surgeons. Used as a mild application to chaps, &c.

CERUMEN AURIS, accumulation of. See Ear.

CHAFING, from the French verb, *chauffer*, to heat. The rubefaction, or erosion of the skin produced by friction, either from the clothes or folds of the skin itself. Infants are subject to suffering from this cause. The best remedy is washing with cold water, and dusting with hair powder, or power of rotten wood.

CHALAZIUM, from χάλαζα, a hailstone; some authors have thus designated the small, hard, round tumours developed in the eye-lids, and in other parts of the body. See Hordeolum.

CHANCRE, *Ulcera cancrosa.* The ulcer that arises from the direct application of the venereal virus to any part of the body. Of course it is most frequent on the sexual organs. It is so named on account of its tendency to spread, and invade the surrounding parts. See Syphilis.

CHARPIE, *carbasus, lintea carpta.* This substance is used in dressing wounds, ulcers, fistulæ, &c. and is prepared by cutting old linen or rags into small pieces, which are then broken up into filaments, or threads. If the threads are thick and coarse, the charpie is called *brute*, but if fine, and softened by being scraped with the back of a knife, it is known as the *charpie rapée.* It forms an absorbent and economical dressing, and in hospitals may be prepared by the patients themselves.

CHEMOSIS, χήμωσις, from χήμη a hole or opening. This term is employed to designate the inflammatory œdema of the subconjunctival cellular tissue of the eye-ball, which occurs in certain ophthalmiæ, by which the conjunctiva, red and swollen, is raised from the sclerotica all round the cornea and made to overlap its edge to a greater or less extent. The centre of the cornea, the only part which is seen, thus appears sunk. See Ophthalmia.

CHEVESTER, identical with Capistrum, a head-bandage. See BANDAGE.

CHIASTER, from χιαζειν to cross. This bandage is so named from its being formed like the Greek letter χ. As a head-bandage it is employed in stopping hæmorrhage from the temporal artery; it is double-headed, about an inch and a half wide and three or four yards long.

CHILBLAINS. See CONGELATION.

CHONDRITIS. — Deriv. χόνδρος, cartilago, syn.

In accordance with the arrangement proposed in the article ARTICULATION, ulceration of cartilage has to be discussed under the head of Chondritis, thereby recognizing the principle that the organization of cartilage is sufficient to give rise to the processes of inflammation and ulceration.

As the condition of vitality in animals of low organization differs from that in those which are furnished with more complicated circulatory and nervous systems, so in cartilage and similar tissues the processes of nutrition and absorption in health, and their modifications in disease, are much less actively carried on than in more complex structures. Thus we know nothing of acute chondritis as a disease *per se*, or of its symptoms before ulceration has commenced, and it remains uncomplicated by articular orteitis, or synovitis. That such a disease does exist, however, the recent microscopic observations of Mr. Liston have placed beyond question.

We know also that the cartilages of an articulation which has suffered from acute arthritis freely admit fine size injection. Sir B. Brodie and others have also seen vessels injected with red blood passing through the substance of the cartilage. This is all we know of the pathology of simple chondritis; for it is, to say the least, very doubtful, whether the softening of cartilage described by Bichat as occurring in some cases of disease of the hip-joint, is the result of primary disease of the cartilage. It would appear also that the hypertrophy, atrophy, and softening of cartilage, should be regarded rather as lesions of nutrition, than as consequences of inflammation. In the forty-eighth volume of the Edinburgh Medical and Surgical Journal, Mr. Gulliver describes some preparations preserved in the museum of the army medical department at Chatham; among these are specimens of hypertrophy, atrophy, and softening of cartilage, and he considers that "these changes appear to originate in this tissue, are often long confined exclusively to it, and are probably altogether independent of inflammatory action." Otto and some others have regarded ossification of cartilage as a proof of pre-existing chondritis; but it will probably appear unlikely that changes, which in the majority of cases are merely the result of advancing age, should be either uniformly or frequently preceded by inflammatory action. In some cases, however, this opinion may be correct; as when after inflammation of the perichondrium, the effect of syphilis or mercury, ossification takes place in the cortal cartilages; or when after chronic arthritis ossification and ebumation of the diarthrodial cartilage follows.

It would be absurd to say any thing on the treatment of a disease whose existence we have no means of determining, in the present state of our knowledge. It is fortunate, however, that here, as in most other cases where diagnosis is extremely difficult, it is of secondary importance — perfect rest, with attention to the state of the general health being the chief indications for treatment in the incipient stages of all diseases of the joints.

We pass, therefore, to the subject of ulceration, and as the pathology of this process has been discussed as far as is thought consistent with the plan of this work in the article ARTICULATION, it is only necessary to state our belief in the vital endowments of cartilage, and its power of self absorption. Fully admitting this, however, it is still probable that the ulceration of cartilage is far more frequently dependent on extension of disease from the bone or synovial membrane, than from primary disease of the cartilage itself, though it remains to be proved that the process is the result of the agency of the synovial membrane, or of any growth or production from it. It is also probable that some of the changes observed in cartilage are the result of the transudation of fluid from the synovial cavity. Sebastian and Schumer of Groningen have carried this opinion to great extremes. The latter, in his work, "De Cartilaginum Articularium ex Morbis Mutatione," appears to regard this as the sole cause of softening and apparent ulceration.

Ulceration of cartilage may take place in several joints simultaneously, or be confined to one alone. It occurs, as a primary disease, most frequently in adults under thirty years of age, and in children before the age of puberty. We have no statistical data as to the sex most usually the subject of this disease; but it is clearly determined that a large majority of its victims have that peculiar condition of the system designated by the terms struma, or scrofula.—It is occasionally referred to local injury, or exposure to cold, and frequently exists in combination with gout, rheumatism, or syphilis, but very often there appears no assignable cause for its occurrence. Pain is the first symptom; it occasionally sets in severe and violent, but is more frequently slight and intermitting; sometimes confined to the joint affected; at others referred to a distant point. This pain is much increased by any sudden jar of the limb, or any considerable motion of the affected joint, especially by bearing the weight of the body on the limb, or in any other way causing pressure of the articular surfaces against each other. Thus, when the knee is affected, the patient limps with the heel raised, so that the least possible approximation of the articular surfaces may ensue. Indeed, considerable motion of the joint can sometimes be borne, provided the limb be a little stretched. The patient rests for a few days, and the pain is removed, but it returns very soon after exercise is resumed, and generally with augmented intensity, more confined in its situation, and followed by a considerable degree of stiffness. When the hip-joint is the seat of the disease, the pain is usually referred to the knee. The head of the tibia is the chief seat of pain when the knee joint itself is affected. In the other joints the pain is usually referred to the actual seat of the disease; but in addition to this, a tormenting sensation of pain and numbness is felt along the shaft of the humerus, when the shoulder-joint is the seat of ulceration. In the case of a lady I was lately in the habit of seeing, this symptom had completely led her physician from the seat of the disease; he considered it pathognomonic of angina pectoris. In case of disease of the elbow-joint also, pain and numbness is sometimes felt in the wrist and back of the hand.

As the disease advances, the pain is accompanied by distressing spasmodic twitchings of the limb, especially at night, and some swelling of the joint becomes evident on examination. The enlargement of the joint is rendered more evident, as the muscles have by this time become considerably diminished in volume in consequence of their inaction. The swelling has the exact form of the articulating extremities of the bones, and is unaccompanied by fluctuation, unless other changes have taken place. There will evidently be fluctuation if synovitis be also present, or if suppuration have taken place, and pus has been discharged into the synovial cavity, or into the cellular tissue surrounding the joint, or sinuses formed in the soft parts, as is commonly the case if the disease have proceeded to an advanced stage. The patient may remain some time in this state, and if unrelieved, will almost necessarily sink under the exhausting pain and protracted irritation.

The course of the disease occupies a very different period in different cases. In some the pain will exist for many weeks, without the presence of any other symptom, but the patient very soon sinks when suppuration has commenced. In other cases the disorganization of the joint advances very speedily, and its effects on the system vary with the general power of the sufferer. We have seen a case in which there was surprisingly little disturbance of the functions, though, as was proved by examination of the amputated limb, effusion of pus and lymph had taken place into the cavity of the joint. There was caries of the ends of the bones, external œdema, and suppuration; and permanent flexion of the limb, with consecutive luxation. This, however, was a very singular case, as almost uniformly such a state of local disease is accompanied by hectic, night sweats, and diarrhœa, and if the limb or joint be not removed, the patient sinks exhausted.

With the exception, perhaps, of this very advanced stage, a reparative process may be set up in any period during the progress of this disease. It does not appear that a perfect restoration of cartilage which has been lost by ulceration ever takes place, the excavation being in the most favourable cases filled by a ligamentous tissue. Even after simple division, it was found by Beclard and Dörner that union was not effected by cartilage. Where the whole of the articular cartilage has been removed, a compact layer of white osseous matter, perfectly smooth and of a marbly hardness, supplies its place. In some cases of chronic rheumatic disease of the joints a total absorption of cartilage takes place, and the bones are exposed, their articulating surfaces being smoothed by friction. The surface is not destroyed: it is preserved, or its place supplied by a growth of ivory-like substance. In the gouty diathesis this layer is sometimes very thick, being a crust of lithate of soda.

The course of the disease as usually observed has been described, but in the eleventh volume of the Medico-Chirurgical Transactions, Mr. Mayo has described a class of cases marked by acute synovitis, not occasioning effusion of synovia; but considerable œdema or suppuration in the tissues external to the joint, with rapid absorption of the articular cartilages, followed by bony anchylosis. Rapid absorption also occurs in those fearful cases of acute arthritis, which occasionally supervene during the progress of erysipelas, phlebitis, and the diseases of the puerperal state. It is necessary, therefore, to make some allusion to these cases.

The general symptoms are usually those of extreme depression of the vital powers, with either a very excitable state of the nervous system, or confusion of the intellectual faculties, often stupor, low muttering delirium, petechiæ, and meteorism. After a short time, the most severe local symptoms commence in one joint, and successively attack several others, or appear in many joints simultaneously. In some cases there is rapid effusion into the synovial sac, without much pain, but more frequently the pain is very acute. This has been especially remarked in the puerperal cases. The integuments are red, turgid, and doughy to the feel, and there is usually a good deal of œdema throughout the whole limb. In a case of this kind, I had lately the opportunity of observing, the subcutaneous veins were remarkably varicose. This is a class of cases in which the ratio of mortality is very high, not so much from the extent of the local disease, although this is so great, as from the peculiar condition of the whole system:—a state in which large deposits of purulent matter take place into various organs and tissues, their structures frequently exhibit no other marks of morbid action.

The cartilages are found of a dirty-white colour, less translucent than when healthy, and softened towards their edges. Sometimes they have a worm-eaten appearance, at others they are partially raised from the subjacent bone. Frequently one edge is quite detached from the bone, so that the portion of cartilage hangs like a valve into the cavity of the joint. Sometimes it is completely separated, floating with a quantity of purulent matter in the remains of the synovial sac. The cartilage is occasionally removed altogether. The other tissues of the joint generally present evidences of the most acute inflammatory action, but sometimes the cartilage is absorbed, and there remains no other apparent disease. I had lately an opportunity of examining the body of a female who died about a fortnight after delivery, with symptoms which were ascribed to puerperal peritonitis. There were, however, no traces of abdominal disease. While examining the organs of the pelvis, our attention was directed to the left sacro iliac synchondrosis by an appearance of bulging in that situation. We found that the cartilages covering the opposed surfaces of the ilium and sacrum had been completely absorbed, and the bones were consequently denuded. There was a large quantity of pus contained between and around the bones, and their abraded surface was covered by an exudation of recent lymph.

Having described the symptoms usually observed in the different classes of cases in which ulceration of cartilage is a prominent symptom, or the principal and primary disease, it becomes necessary to allude to the diagnosis of the chronic cases from other diseases. They may be mistaken for inflammation of the synovial membrane; articular osteitis; scrophulous deposit in the articular extremities of the bones; the peculiar change of structure in the synovial membrane described by Sir Benjamin Brodie; inflammation of the ligaments; external chronic abscess; inflammation and effusion into a bursal sac; and neuralgia.

The diagnosis of ulceration of cartilage from inflammation of the synovial membrane is not difficult. In synovitis the pain is at first severe, but gradually diminishes; in ulceration, on the contrary, it is as a general rule at first slight, gradually increasing, and is aggravated in a far greater degree by any approximation of the articular extremities of the bones. In synovitis the swelling occurs simultaneously with, or very soon after the first attack of pain: in ulceration patients generally suffer very severe pain for weeks before any swelling is discoverable. In synovitis the form of the swelling is characteristic, from the bulging of the fluid at those parts of the joint unprotected by ligaments: in ulceration the swelling has the form of the healthy joint. In synovitis there is fluctuation throughout the disease: in ulceration there is no fluctuation till suppuration has taken place.

Caries of the head of the bones is marked by its slow progress, and the earlier occurrence of swelling. In the scrophulous cases there is very little pain, and far more swelling than in the case of disease of the cartilage; there are other marks of a scrophulous diathesis; the disease rarely occurs after puberty; the swelling does not take the form of the joint, but gives an appearance of enlargement of the head of the bone, so peculiar, that those who have observed it once, will not fail to recognize it. Suppuration, when it comes on, is not confined to a single collection of matter, but forms a succession of abscesses.

In the words of Sir Benjamin Brodie, the gelatinous degeneration of the synovial membrane is marked by "the gradual progress of the enlargement and stiffness of the joint without pain, and the soft elastic swelling without fluctuation, in the majority of cases, enable us to distinguish it readily from all the other morbid affections to which the joints are liable [1]."

Inflammation of ligaments is marked by the superficial character of the pain and its increase, not by all motions of the joint, but only by those which put the affected ligaments on the stretch. This is characteristic. The absence of the other symptoms of ulceration of cartilage will also be remarked.

The circumscribed nature of the swelling which results from bursal inflammation, its chronic character, the absence of pain, together with the occupation of the patient, will be sufficient to detect the nature of the disease in its early stages on the most cursory glance. But if suppuration have taken place, the sac have ulcerated, and pus has been discharged into the cellular tissue around the joint, a mistake may be made. In order to show that this error is not an imaginary one, I may state, that I knew of a limb which was condemned to amputation, though this was the sole disease. The diagnosis is, of course, most simple, especially if the disease occur in the knee or elbow, as is almost invariably the case. If the pus were within the joint, it would be internal to the patella or olecranon, whereas in the other case it is external. The other marks of disease of the cartilage are also wanting.

To those who have not seen much of articular diseases, it may appear unlikely that mere chronic inflammation of the soft parts around a joint, attended by suppuration, should be mistaken for serious disease of the joint itself. Such, however, is not unfrequently the case; and sometimes the error is very far from a gross one, though an attentive enquiry into the history and symptoms would suffice to establish the diagnosis. Thus, if we compare the symptoms with those of ulceration of cartilage, we find that evident tumefaction is one of the earliest signs of chronic inflammation of the soft parts; there is also more stiffness of the joint in the early stage: the pain is more confined in its situation; aggravated in a less degree by motion of the joint, but in a greater by superficial pressure over the seat of pain: it does not increase to the same severe extent, nor is it accompanied by the startings of the limb: it is not so much relieved by rest. It will be remembered also that generally speaking it is some months before suppuration takes place from cartilaginous disease.

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[1] Pathological and Surgical Observations on the Diseases of the Joints, p. 86.

Sir Benjamin Brodie states that a large majority of the cases of suspected diseased joints which occur in fashionable practice are nothing more than neuralgic affections. The same assertion may be made with perfect accuracy in the case of certain unfortunate females, who frequently fall under the observation of the general practitioner. Their irregular habits of life; the mental distress many of them suffer; the state of nervous excitement common to the order; and its increase by means of ardent spirits in the large majority, induce a state of system which predisposes to diseases of the same character as those which result from more refined dissipation. The most severe pain is felt in the neighbourhood of some joint, and as this is for some time unaccompanied by other symptoms, it is more likely to be mistaken for ulceration of cartilage than any thing else. The diagnosis, however, is not difficult. The general appearance of the patient is that of an hysteric nervously excitable person—her mode of life is probably such as tends to exhaust or cause irregular distribution of nervous influence—probably there is neuralgia in other parts,—but even suppose, as is sometimes the case, the patient appears florid and healthy, even then the symptoms are characteristic. The pain at first comes on in paroxysms, the intermissions being perfect; it is evidently seated in the integuments; there is extreme tenderness on the slightest touch, while on continuing the pressure, considerable force may be exerted, and the pain be thus removed. The pain is not confined to the joint, and remains for a considerable time without other evidence of local disease, and when swelling does come on, it is a diffused œdema. Frequently extensive motion of the joint can be borne without pain. These marks are quite sufficient to establish our diagnosis, but we must avoid the other extreme, and not be led by the presence of neuralgia to infer the absence of organic disease. As far as my personal observation has gone, I should be led to doubt the position that simple morbid irritability of any tissue can continue for any considerable length of time, without inducing increased arterial action.

Having described the symptoms by which ulceration of cartilage may be discovered and distinguished from diseases for which it is liable to be mistaken, it may be well before proceeding to the subject of treatment, to allude to the morbid appearances observed in joints so affected. In this, as in the other departments of the subject, we purposely abstain from speaking of the disease as it occurs in the hip-joint. It will be treated in a separate article under that head.

If an opportunity be obtained of examining the joint of a person who has died in an early stage of this disease, it is found that the ulcer has commenced on the free surface of the cartilage, and towards its centre. Pus is by no means necessarily present. Vascularity is not evident to the unassisted eye, and the bone and synovial membrane are healthy. The ulcer is a mere excavation, generally superficial, with irregular edges, the surrounding portion of cartilage being healthy, or only slightly altered in colour.

In the more advanced stages of the disease the other structures participate in the morbid action. Thus in the knee, though occasionally the cartilages have been found in a state of ulceration, or even completely removed, neither the bone nor synovial membrane being affected, the bones are more frequently carious, and the synovial membrane has undergone important structural changes. The cartilages and synovial membrane have also been found completely absent, the tibia and femur being connected together by processes of organized lymph. In the ankle the chronic ulceration of cartilage is almost invariably connected with strumous caries of the heads of the tibia and fibula, or of some of the tarsal bones. In the wrist joint, the carpal, carpo-metacarpal, metacarpo-phalangeal, and phalangeal articulations, ulceration of cartilage is rarely a primary disease, but frequently an effect of injury, strumous or malignant disease of the bones, neglected paronychia, or the deposit of lithate of soda under the influence of the gouty diathesis. Any of these cartilages may be found in a state varying from the existence of a simple ulcer to a total removal, in which case ankylosis by means of a fibro-cellular substance is common: but occasionally the place of the cartilage is filled by porcelainous deposit. Sometimes when acute synovitis has existed in the elbow-joint, and opportunity occurs for post mortem examination, the cartilages are found to have enjoyed a remarkable immunity from disease, preserving their natural colour and texture throughout, while the synovial membrane has undergone extensive morbid changes. We remember a case of this kind where the only change in the cartilage was, that it had become of the colour of horn, its consistence remaining unaltered. It is occasionally seen softened in patches, the softened portions being raised from the bone by an organized substance between the bone and the osseous surface of the cartilage. The softened portions are sometimes perfectly detached, floating in the cavity of the articulation, and in old standing cases the bones are entirely denuded. Mr. Adams of Dublin has described a condition of the elbow-joint, which is very far from uncommon, depending on chronic rheumatism, where "the cartilages are removed from the heads of the bones, which are greatly enlarged, and their articular surfaces are covered by a smooth porcelain-like deposit, and after a time attain the polish and smoothness of ivory[1]." In cases where the radio-humeral articulation was also affected, and the head of the radius had assumed a globular form, Mr. Adams saw the cartilage "removed altogether, and its place occupied by an ivory-like enamel[2]." In other cases he has found "the bones of this articulation enlarged, hard, and presenting a rough porous appearance, while the cartilage was entirely removed: but in these cases no ivory deposit was formed. These were cases in which the same disease existed locally, and the same disposition prevailed in the constitution: but from the bones having been kept in a state of quietude, the rough surfaces of the articular extremities had not been smoothed by the effects of friction, nor an ivory-like enamel formed."

In the shoulder the cartilage is found dull, softened, raised from the bone to which it is less adherent than usual, partially or wholly detached, and often has a worm-eaten appearance. The termination will be either formation of ivory deposit, ankylosis, or total destruction of the joint.

Treatment.—The diagnosis and treatment of diseases of the joints is a department of surgery in which we have decidedly taken the lead of our continental neighbours. For this superiority we are almost entirely indebted to the acumen and industry of Sir Benjamin Brodie. Until his important researches had been promulgated, the treatment of these diseases was an opprobrium to our art. Affections of the most opposite character, which demanded very different treatment, were grouped together under the same appellation, and the same routine of remedial means was gone through. Whenever a joint was the apparent subject of disease, a course was commenced consisting of local bleeding, blisters, frictions with various stimulating substances, caustic issues, moxæ, or setons, and frequently the internal exhibition of mercury. But the profession having no fixed principles for their guidance in their application of the therapeutic agents, they were employed in an irregular and capricious manner, were consequently of little avail, and the joint was doomed to the knife, if within its scope; or if not, the sufferer was left to his fate. Sir Benjamin Brodie pointed out the different diseases to which the joints were subject, the means of distinguishing them from each other, and the treatment beneficial in each disease, and now without any addition to our remedies many limbs are preserved which would formerly have been sacrificed, simply from the manner in which our increased knowledge leads us to direct the application of those remedies.

The indications for the local treatment of a joint, the cartilages of which are ulcerated, are to prevent any increase of the morbid action from motion, shocks, or any other cause of irritation. Then regarding the ulcerative process as the result of chronic inflammatory action to lessen and subdue this by means of counter irritation.

The first object is to keep the affected joint in a state of the most absolute quietude, for if the disease be recognized in its early stage, and the joint be carefully retained in a state of complete immobility, the excavated surface will become filled up with a ligamentous tissue, and the joint be restored to an almost perfect condition. In the more advanced stages the soft or bony ankylosis is the most favourable termination that can be looked for, and this can only be insured by maintaining the joint in a fixed position. Various plans have been recommended for the purpose of fixing the joint. Common splints well padded are often applied with this intention, but they are inconvenient, and cannot be made to retain their position with perfect accuracy for any length of time. Leather moulded to the form of the joint, or wetted pasteboard, answer better, but they are inferior to the bandages stiffened with starch, albumen, or resin[1]. A common calico bandage well covered with mucilage of starch may be rolled around the affected joint, and for some distance above and below it. This adapts itself to all the inequalities of the surface, and when it has dried, a sort of immoveable case is formed, which effectually prevents motion, and keeps up a slight degree of uniform pressure around the joint. The objections to their use are the length of time they require to dry, and the softening they undergo if much perspiration exude from the limb. On both these accounts albumen affords a preferable mode of forming an immoveable apparatus. It may be applied on layers of tow, or carded cotton, and allowed to dry; or it may be first thickened with flour, and the joint having been covered with a layer of soft lint, the mixture is to be spread into slips of calico cut into the form of splints, which should be applied on each side of the joints so as to cover it, and secured by a bandage. This is a very efficient mode of procedure, but a spirituous solution of some of the gum-resins would probably be superior, as from the rapidity with which spirit evaporates they would soon dry and leave a stiff bandage, on which cold lotion might be readily applied if desirable. It remains to be proved whether this could be effected and the bandage remain unsoftened by the temperature of the limb. Whether this be so or not, by placing the joint in such a position as shall relax the principal muscles acting upon it, and by applying the wetted pasteboard, the egg and flour splints, or the starch bandage, we have it in our power to keep the limb in a state of perfect rest, and as these means are effectual for the purpose, it is submitted that they should be universally adopted, if there be no inflammatory condition of the soft tissues to contra-indicate their employment, though their application must in some cases be delayed, to give time for counter irritation.

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[1] Cyclopædia of Anatomy and Physiology, vol. ii. p. 79. [2] Ibid.

[1] Sir B. Brodie thinks, on the whole, that the leather splint is best, as it is capable, if necessary, of being so easily removed. It is very well made by Mr. Sparkes of Conduit Street.

Velpeau employs a paste called dextrine for stiffening bandages. It is prepared by boiling starch in diluted nitric acid. A precipitate forms, which is to be separated and dried. This powder is made into a paste with cold water, and is said to be more effectual than any other adhesive material, but the bandages take several hours to harden. Mucilage of gum-acacia thickened with chalk has been recently used, and is understood to have answered very well. By any of these means we have an apparatus easily procured, readily applied, and as speedily removed: a gentle and uniform compression is exerted on the limb, the joint is kept immoveably fixed, and a patient who, under other circumstances, would be confined to a sick chamber, is enabled to walk in the open air with the assistance of crutches, and as the bandages are very light, and adapt themselves to every irregularity of the surface of the limb, the joint may be kept in any position that is desired.

Mr. Scott has recommended a mode of giving mechanical support to a limb, a joint of which is the subject of disease, and preventing all motion of the parts. His plan appears to possess some advantages, and might be adopted if it were thought desirable to vary the more simple means recommended above, but we cannot speak of its efficacy from personal experience. The limb is covered with a mixture of equal parts of ceratum saponis, and unguentum hydrargyri fortius cum camphorâ thickly spread on lint, and over this strips, an inch and a half wide, of the emplastrum plumbi spread on calico are to be applied. Then a covering of emplastrum saponis, spread on thick leather, the whole being uniformly supported by a bandage. Before making these applications the limb is to be cleansed, and gently rubbed with camphorated spirit, to induce a gentle excitement of the superficial vessels. Mr. Scott here trusts not only to the quietude, but also to the influence mercury has been found to possess in subduing chronic inflammation when applied locally.

Of the means in use for the purpose of subduing the morbid action going on within the joint, local blood-letting is one of the most obvious. It is occasionally indicated when from some irritating cause, as a slip, a violent starting of the limb, the inflammatory action has been augmented; also, whenever there is much increase of heat about the joint accompanied by constant pain. But if employed when the constitutional powers of the patient have been greatly impaired, and there is any considerable emaciation, though it may for a day or two mitigate some urgent symptom, it is almost invariably followed within a week by an aggravation of suffering, and evident marks of a rapid increase of the disease. Some apply cupping-glasses over the leech bites, so as to remove a determinate quantity of blood, but I have observed that the relief afforded in this manner is not so great as when the blood is allowed to ooze into a soft warm poultice. Warm and moist applications are sometimes useful as palliatives. Cold ones often increase, and but seldom relieve suffering.

In children, blisters kept open with some irritating dressing, afford much relief to the pain, and if the limb be kept quiet, this may be all that is necessary: but in adults, issues made with caustic potash, or the potassa cum calce, are far more serviceable. Sir Benjamin Brodie says they have a greater effect over ulceration of cartilage than any other disease of joints. They should be made as near the joint as is compatible with the safety of the synovial membrane. In some cases the first application is followed by an immediate cessation of the symptoms; in almost all, considerable relief is afforded, and if quiet be maintained for some weeks, the cure is often completed. Sir B. Brodie remarks, that the benefit derived from the issue does not appear to be in proportion to the quantity of pus discharged from its surface, and he thinks it is a decidedly better plan to keep the issue open by rubbing it two or three times a week with caustic potash, or sulphate of copper, than to employ beans. When these issues are applied, however, in combination with the ordinary methods of fixing the joint, their good effects are often destroyed by the involuntary motions of the limb. It is evident that the effects are likely to be far more beneficial when the joint is kept perfectly immoveable, and to effect this after applying the starched bandage, I have removed a piece about the size of half a crown, and applied the potassa cum calce to the skin at this spot. In this way perfect rest and the benefit of the issue were simultaneously and easily obtained.

The application of moxæ, and the formation of eschars by means of heated irons have been much recommended, and were formerly in pretty general use in articular diseases, but they have of late years been superseded by caustic issues and setons. Most patients have a great horror of the actual cautery, and the difficulty of regulating the extent of their action is another strong objection to all the usual modes of cauterization. Instances are on record in which the synovial membrane was penetrated, and the most deplorable results followed. The evils, however, which arise from the abuse of a remedy, are not arguments against its proper use, and I believe that moxæ, when properly applied, are more manageable and efficacious than any other form of counter-irritation. The simplest and best, with which I am acquainted, is made with paper which has been steeped in the liquor plumbi diacetatis, and afterwards dried. This is folded into a narrow strip, and rolled up after the manner of a bandage, till it gives a surface about the size of a sixpence. It is held on the point of skin where we wish to make the eschar by a pair of forceps or scissors, and a light applied. By blowing on it it burns brightly like tinder without flame, and produces an eschar of sufficient extent which separates in a day or two. They may be applied in this way in conjunction with the starched bandages, by cutting out a small piece of the latter, and thus all the benefits of counter-irritation may be secured, with perfect quietude of the limb. In Paris, agaric has been lately used to form moxæ, and it answers the purpose very well. Severinus and Rust are the principal advocates for the actual cautery. The latter author is very minute in his directions as to the mode and extent of its application, but it appears unnecessary to describe his practice, as all the benefits may be derived from the moxæ I have described, without any of the ill effects which have been observed to follow the hot iron.

Various plasters have been recommended, as the emplastrum hydrargyri cum ammoniaco, but they are altogether useless, and much valuable time is often frittered away in waiting for their expected effects. All species of stimulating or sedative liniments are highly injurious, from the friction employed in their application. Here then is one point showing the great importance of making a correct diagnosis.

Setons are very useful in relieving severe attacks of pain. They effect this desirable object more speedily than issues, but their good effects are by no means so permanent. I remember a case where I passed a seton just behind the shoulder-joint, which had the effect of almost immediately relieving agonizing pain, which had continued for several days, accompanied by extreme tenderness on pressure.

When suppuration has taken place, the prognosis is much more unfavourable, especially in adults, and the question of treatment becomes one of increased importance. It is often a matter of difficulty to say whether a collection of pus in the soft parts does or does not communicate with the joint, and so long as this is uncertain, it is better not to open it, unless it appear to be extending along the limb. Of course if it be superficial the sooner it is discharged the better. If we know that the pus is in communication with the cavity of the joint, the general opinion of surgeons is against its artificial evacuation. If left there, we have to consider the probability of its increase, distension of the ligaments, consequent yielding of the bones to muscular influence and consecutive luxation, besides the changes Schumer has shown so frequently to result from the transudation of pus to the articular tissues. If opened, we have the chance of speedy death, (which, to my knowledge, has happened in more than one instance,) the increase of local action, and a secretion of pus so great, that if the opening close, the abscess is as full in two or three days as it was before: if it remain open there is a profuse and exhausting fetid discharge. Therefore, as these dangerous consequences do not follow when the abscess opens spontaneously, and as the pus is sometimes, though very rarely, absorbed, it is better not to interfere as a general rule. The abscess must not be squeezed after either artificial or natural opening, but a degree of gentle and uniform pressure kept up by bandaging.

Rust recommends that before opening an articular abscess, the integuments over it should be inflamed by the cautery, and after a few days the eschar is to be divided, and the matter evacuated. He does this with the view of exciting a condition of the skin similar to that which exists in a simple abscess, a condition in which the walls of the abscess have a tendency to contract and adhere. When the abscess is large he passes a red-hot trocar through it, and introduces a seton through the openings, leaving it there for twenty-four or thirty-six hours. Petit and Larrey make the opening with a small heated knife, and apply cupping-glasses to remove the matter. Others have made the puncture under water, but it does not appear that the danger in these cases arises from the access of air; or if so, that any such methods can obviate this occurrence.

When the general powers of the patient are evidently suffering from the effects of the local disease, and no reasonable hope can be longer entertained of effecting a cure, even by ankylosis, the only remedy is the removal of the diseased joint. Until the operations of Moreau, Jeffray, and Park, had been performed, amputation was considered to be the only means of effecting this object. But these cases, and many others which have been recently recorded by Syme, Key, &c. have proved that a very useful limb may be preserved by removing the articulation. It may be questioned whether the remnants of limbs remaining after excision of the ankle or knee-joints are at all equal to the firm and steady support afforded by an artificial leg. But with regard to the removal of the elbow and shoulder joints, not only are the motions and uses of the hand perfectly preserved after the operation, but so much motion is allowed between the divided extremities of the bones, that the ordinary motions of the joint remain to a surprising degree. This, therefore, appears to be a great improvement in modern surgery, and one which should be carefully considered before proceeding to amputation. See Resection.

Before amputation be decided on, the lungs should be carefully examined, for I have now seen three instances in which very extensive pulmonary disease existed in cases of diseased joints in scrofulous patients (and which, it was thought, had commenced in ulceration of cartilage,) the general symptoms of pulmonary disease being singularly latent. There was in fact nothing to induce a supposition of chest affection, while very extensive disease was evident on auscultation. Amputation in such cases would be useless torture, and the surgeon would have the credit of hastening his patient's death. I believe many of the cases we used to hear of, where disease was said to commence in the lungs as soon as the diseased joint is removed, are to be accounted for in this way: the lungs being diseased, but the symptoms rendered latent by the action going on in the joint. On the other hand, if the lungs be sound, and there is no hope of saving the joint, the sooner it is removed the better, as the local irritation, if long protracted, will almost certainly be a cause of disease in some vital organ. See AMPUTATION.

As to the general treatment, the grand object is to support the powers of the patient. Pure air is of the first importance, and it is much to be regretted that the wealthy and charitable should rather support institutions in unhealthy neighbourhoods, than establish a convalescent hospital in some healthy locality. Where the circumstances of the patient permit, a spot should be selected where the temperature is not liable to sudden vicissitudes, and where there is not much cold or moisture. The diet must be simple and nutritious, but unstimulating. As much exercise as can be taken without causing motion of the limb is to be enjoined. The clothing must be warm in the day time, but it is an error to cause perspiration at night by too many blankets on the bed. The state of the digestive organs must be attended to, but the simpler the medicines that are used the better. I have often seen much benefit from rhubarb in moderate doses with carbonate of soda and infusion of gentian. This has appeared to keep the bowels in a regular state, and at the same time obviate the capaciousness of appetite so often observed in these cases, better than more complicated formulæ. Sir B. Brodie strongly recommends sarsaparilla to be given in full doses for a considerable period. The lighter tonics will also prove serviceable, among which the salicine is by far the best, in doses of from five to ten grains three times a day. An occasional opiate will sometimes be required. As to specific remedies, mercury should be altogether discarded, but in all cases where not expressly contra-indicated a fair and full trial should be given to the iodide of potassium, and from what I have seen of its effects I am led to expect the happiest effects when its use is commenced before extensive disorganization of the joint has come on.

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CHORDEE, *Chordata Gonorrhea.* A painful affection of the penis, which sometimes accompanies gonorrhea, and is mostly troublesome during the night, when the organ is in the state of erection. See GONORRHEA.

CHOROIDITIS. Inflammation of the Choroid. See AMAUROSIS.

CHRUPSIA, more correctly CHROOPSIA, from *χροα*, *colour* and *οψις*, *vision.* Coloured vision. In the healthy state, the eye is to all intents and purposes an achromatic instrument, but its dioptric parts may be so deranged or suffused as to decompose the light, and make objects appear as if surrounded by the colours of the rainbow. This effect may also be produced by inflection merely, as is seen by closing one eye and looking at printed letters with the other over the point of the nose. But the form of coloured vision which particularly merits the attention of the practitioner, is that depending on some affection of the nervous apparatus of the eye, and therefore, occurring as a symptom of AMAUROSIS, which see, as also EYE.

CICATRIX, cicatrice, Fr. *Narbe*, Germ. *ουλη*, Gr. The word cicatrix is by some authors derived from *cæcare*, to blind; by others from *κικυω valeo* or *κηκις nidor;* but I am disposed to believe that its true etymology is unknown. It is employed in surgical pathology to denote the mark or scar left after the healing of a wound or ulcer.

A cicatrix is in every case the result of a deposition of lymph which becomes condensed, organized, and presents a fibro-cellular character, forming what Delpech has termed *inodular* tissue. As it is composed of a newly organized substance, it does not resemble any of the natural structures. At first thin, delicate, and fragile, it appears redder than the adjacent skin, the subjacent vascular layer being partially visible through the translucent web. It is also, from close adhesion, stiff and immoveable, but gradually becomes more supple, and at the same time more compact, in consequence partly of the repeated movements and extension of the parts, and partly of the absorption of the effused and thickened lymph in adjunct structures. It is highly susceptible of injury from slight mechanical or chemical causes; and is likewise prone to give way and ulcerate during certain morbid conditions of the system. Imperfect suppuration and slowness of the reparative process indicate its low degree of vitality and organization when subjected to external injury.

The cicatrix in proportion as it acquires strength and solidity assumes a white appearance, owing to the scanty supply of blood-vessels. It is destitute of the natural sensibility of the skin, no sentient nerves having ever yet been traced into its substance. It does not possess sebaceous glands, exhalents, or absorbents, and is incapable of furnishing hairs, or generating the villi which belong to the original cutis. The rete mucosum is slowly, if ever reproduced, hence the cicatrices of negroes remain for a long time white or yellow, and indeed never acquire exactly the same tint as the neighbouring surface, being either yellowish brown or intensely black. Not so the epidermis on the cicatrix, for its presence can be demonstrated during life by the application of a blister, and after death by maceration in water. The cellular texture underneath a cicatrix is dense and compact.

Whatever tends to increase the vascular appearance of the skin, or to produce a local plethora in the capillary net-work, renders scars more palpable from contrast. Thus when the countenance is flushed by the effect of passion, violent exercise, or excitement, scars are readily distinguished, from their extreme whiteness, and from their relatively depressed condition beneath the level of the skin. This depression of the cicatrix, observes M. Breschet[1], is to be ascribed to the circumstance of its structure being essentially fibrous, or of a nature analogous to the white fibre of tendons and aponeuroses. This texture is more dense and compact in recent than in old cicatrices. Accordingly, the depression progressively diminishes with time. The more abundant and lax the subjacent cellular texture, the less will the cicatrix be depressed, as is proved by the result of surgical operations on the lips or scrotum. This pitting applies particularly to cicatrices which follow accidental breaches of surface, and which unite, as it is commonly expressed, by first intention. Whereas the cicatrices of wounds which have healed by suppuration, and of which the causes and forms may vary exceedingly, do not always display this appearance, but, on the contrary, present an elevated instead of a hollow surface.

Cicatrices are for the most part indelible. Their external appearance and form ought to be carefully studied by the surgical pathologist, as he may be thereby enabled to discover diseases with which the subject has been previously affected. Every practitioner familiar with wounds can at once distinguish the linear scar of an incised wound, from the uneven and tuberous scar of a contused wound, or the minute, round, puckered scar of a punctured wound, from the somewhat similar though more irregular and profound scar of a gunshot wound. The profession is indebted to Dr. Ramberg, for an elaborate description of the cicatrices which follow specific ulcers of different kinds[1].

The cicatrix from a *scrofulous* ulcer is uneven, plicated, furrowed, radiated, presenting several deep pits; it is usually white, smooth, and glistening, and frequently bounded by a hard uneven margin: that from a *scorbutic* ulcer is of a deep bluish-red hue, soft, elevated, sensitive, and easily ruptured, giving way at insulated points, and forming minute ulcers which rapidly enlarge; after a lapse of years it becomes more flattened, has a brownish-red cast passing to green at the centre, while the circumference is of a pale brown; it appears puckered, thin, and easily displaced, seeming loosened as it were from its basis: that from an *arthritic* ulcer, generally met with in the proximity of the joints, especially of the lower extremities, has usually a large but irregular and jagged surface, uneven and full of numerous depressions and elevations, of a dusky red passing into a blue or ash colour; its confines are dark brown, varicose, liable to attacks of erysipelatous inflammation, synchronous or alternating with fits of gout: that from an *herpetic* ulcer is very diffuse, having an irregular devious compass, but lying very superficial; it has a dirty reddish-brown aspect passing into gray or blue, though portions of the centre retain the colour of the original integument; it is quite even, blending imperceptibly with the adjoining skin, which together with the cicatrix is generally covered with scales and crusts: that from a *syphilitic* sore varies according as the ulceration has occupied glandular, cutaneous, or mucous structures; the glandular cicatrices are uneven, puffy-looking, sunk in, hard, firm and of a reddish brown or coppery hue; the scars upon the skin are limited in size, more or less round, accurately defined, somewhat deep, at first of a brownish-red colour which gets gradually paler, leaving behind a dull brownish stain; those on mucous surfaces resemble the last, except in colour, which is more of a blueish-red.

The cicatrix of an ulcer of the intestines always appears depressed, unless the other tunics besides the mucous are involved. It is also smooth, soft, and pliant, and has no disposition to contract, so that it is of the same extent as the ulcer that preceded it. In cases of severe dysentery, however, the cicatrix is white and puckered, and very similar to one which would remain after a similar ulceration on the surface of the body. In a few rare instances after the cure of psoas abscess, the cavity remains in the state of a thickened and contracted cyst, holding a serous fluid or containing air. The interior surface of all such cavities nearly resembles the lining of sinuses[2].

Powerful chemical agents, as the various caustics and escharotics, which not only effect a separation of organic parts, but at the same time destroy their texture, produce large unseemly and irregular scars, which, more particularly when the corrosion has penetrated deeply, exhibit a number of dilated anastomosing vessels filled with dark blood.

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[1] Dictionnaire de Médecine, Article "Cicatrice."

[1] Rust's Handbuch der Chirurgie, Bd. v. p. 19.

[2] Macartney on Inflammation, p. 65.

The cicatrix resulting from a burn differs in appearance according to the amount of injury. Thus, where from protracted suppuration the *rete mucosum* is completely destroyed, the cicatrix is white from the absence of *pigmentum nigrum*. Where, on the other hand, the *rete mucosum* is scathed without being entirely destroyed, the colouring matter acquires a much deeper shade than natural. Hence the yellow, tawny, or brown stains which the scars exhibit when perfectly healed, are for the most part permanent, or at all events but slightly modified by time. In the negro, the colour of the cicatrix is much deeper than the natural skin. Where again it is destroyed in certain points, and preserved though changed in others, the cicatrix presents a kind of mottled appearance ; the *rete mucosum* being either not reproduced or else reproduced very imperfectly on the points where it has been destroyed, the prominences thence resulting have a white colour ; while the points of the skin corresponding to those where the *rete mucosum* has been merely altered, have a more or less brown tint. A valuable practical hint is deducible from the above facts, namely, that we should avoid as much as possible applying blisters for any length of time on parts habitually exposed to view, especially in the case of females, from the risk of producing unsightly scars.

But one of the great inconveniences attending extensive burns, arises from the irregular shape and extent of the cicatrix which is formed, and its subsequent absorption. This peculiarity, says Dr. Macartney[1], would seem to depend on the cicatrix involving so much of the skin, in consequence of new organized lymph or granulations being formed on the cutaneous tissue, which has been only imperfectly destroyed, and the basis of the true skin being afterwards removed by absorption along with the structure of the cicatrix.

It is the duty of the surgeon to watch attentively the progress of the cicatrix, and when necessary to employ judicious measures for moderating its extent, and counteracting deformity. Any liquid exudation from the surface ought to be gently wiped off, as it is apt to give rise to crusts or furfuraceous scales, which when allowed to accumulate may prove a source of irritation and ulceration. The cicatrix ought likewise to be protected against external impressions, especially when recent, or situate in the proximity of important organs like the brain, as occurs after trephining, or fractures of the cranium with loss of bony substance. A moderate degree of warmth will be proper, as cicatrices are very sensible to atmospheric vicissitudes. Thus, persons often complain of a feeling of uneasiness and cold in them on the approach of winter. They are, moreover, prone to become chapped and to ulcerate during the prevalence of frosty weather.

Neuralgia of the cicatrix is a most painful and often a most intractable disease. When perfectly local it sometimes yields to surgical treatment, and Mons. Larrey has instanced several cases in which he succeeded by destroying the cicatrix through the application of the actual cautery. Where the mischief exists at the origin of the nerve, art is unavailing.

A swollen state of the cicatrix frequently persists after certain operations, as that for hare-lip, depending on non-absorption of the effused lymph. Here Mr. Wardrop informs me blistering will be found a very effectual remedy. When tumours form, they must be removed by the knife.

A tense, contracted, and rigid cicatrix constituting a hard band, is a frequent sequel of severe burns. To get rid of this defect, of which the preventive treatment will be detailed in the article CICATRIZATION, various means have been suggested. Dupuytren recommended the following practice :—

1. To make several transverse incisions at short distances throughout the whole length and thickness of the band, without removing any portion of its substance, so as to enable the surgeon to extend it readily.

2. To stretch afterwards the parts in a direction opposite to that to which the injury had brought them, in order to obtain a cicatrix with the production of a new cutaneous structure.

This extension requires to be managed with great circumspection, by means of bandages and mechanical contrivances, because serious consequences, as intense pain, violent inflammation, and gangrene have been known to ensue where due precautions had not been employed. Indeed, even in spite of the best directed efforts mischief has resulted, as exemplified in a case adduced by Delpech, the author of a mode of treatment just the inverse of the above. He maintains that in deformities of this description we may expect a cure only, provided we can remove in totality the " morbific organization," and that this being done, sufficient loose skin remains to admit of the parts being approximated in the counter-direction to that caused by the deformity, and brought into immediate union. Of the two, this latter method assuredly deserves the preference where sufficient skin can be saved, since by direct union we obviate the production of new *inodular* texture, and the consequent recurrence of deformity. But the practice is clearly inadmissible where the cicatrix is extensive and tortuous.

Another means of accomplishing the same object is by making lateral incisions in the neighbouring integument, or by determining a loss of substance followed by a cicatrix, which would tend to divert the part into an opposite direction. This latter plan has been applied with great success in the instance of *trichiasis ;* an affection dependent on scarring of the inner margin of the lid, and susceptible of removal by the formation of a corresponding scar on the outer lid, effected either by excising a portion of the skin or by destroying it with the actual cautery.

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[1] Op. cit. p. 63.

It deserves attention that whenever the adjunct or subjacent textures are unhealthy, the cicatrix is the point where primary or secondary disease is first developed. Thus, when a virus of any kind has been introduced into the substance of the skin, there the local symptoms are manifested, simultaneously with the phenomena of constitutional disturbance. It is in the cicatrix again that we generally find the first traces of relapse of cancer, most commonly in the form of circumscribed indurated tubercles, prone to ulcerate from very slight causes.

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CICATRIZATION, Germ. *Vernarbung.* This term is applied to the process whereby wounds and ulcers are healed. It may take place under one of two conditions; namely, that of direct union, called healing by first intention; or that of indirect union, called healing by suppuration.

In the instance of direct union, we find the following order of events: 1st, Effusion of fibrinous lymph. 2d, Cellular organization of this lymph; and 3d, Inosculation of the vessels of the opposite sides. The first step towards healing, consists, according to Dr. Henle[1], in the formation of the so called *primary cells.* These make their appearance in the scanty exudation shed betwixt the edges, or upon the surface of a wound. Their envelopes lengthen out in the shape of tubes or filaments, which by coalition with other filaments, are ultimately transformed into cellular substance, which is the matrix of every cicatrice. "During the first twenty-four hours," says Mons. Serres, "the membrane formed by the exudation is white and areolar; in forty-eight hours, or sometimes earlier, it is already permeated with blood-vessels; the third or fourth day it is still more vascular. When from five to six days have been allowed to elapse, it is often so firmly organized that as much violence is necessary to rupture it as the neighbouring sound parts." This, however, is not always the case, for sometimes the new-formed structure gives way when very slight force is used.

This plastic exudation, this vascular development, takes place independently of inflammation; indeed inflammation is rather an obstacle to the progress of cicatrization. "Frequenter enim vidimus cum integrum crus brachiumve abscissum esset, coaluisse tamen vulnus antequam inflammatio oboriretur[1]."

In the instance of union by the second intention, that is, by suppuration, one portion of the primary cells is gradually transformed into cellular texture, as above described, while the remainder is thrown off in the form of purulent matter. The formation of pus is essential to that of granulations, and is, of necessity, antecedent[2]. Granulations are characterized by the uppermost layers being composed of cells quite analogous to the puriform granules, while those underneath display the envelopes of cells, exhibiting the several stages of transition into cellular fibres, as in the case of immediate union. Hence, it results that the formation of new cells proceeds always upon the surface of the granulations, while, at the same time, the organization is advancing from below upwards. So soon as the granulations have attained the level of the superficial integument, the exudation ceases, and the primary cells no longer furnish cellular texture, but skin[3]. It would appear, farther, that the first rudiments of blood-vessels are to be found in the primary cells, and that these cells shoot out processes, whereby inosculation takes place with each other and with the adjoining capillaries.

When the process of cicatrization is to take place on the surface of granulations, it usually commences on the edges of the ulcer, and proceeds gradually thence to the centre. Preparatory to the final act of healing, we observe that the granulations on the edges of the sore are reduced to a flat surface; the vascularity of the edges about to cicatrize declines, and the thin pellicle which covered the granulations becomes opaque and thicker. "It is indispensable also," observes Dr. Macartney[4], "that inflammation should have ceased in the skin immediately surrounding the sore. The blood-vessels, which previously ascended to the surface of the granulations, now give place to vessels that are extended from the skin to the surface of the cicatrix in a radiated manner; as may be demonstrated by the injection of the limb with a coloured fluid, in a case of recent formation of a cicatrix. These vessels, which at first form but few cross communications with each other, ultimately acquire more of the reticulated arrangement of the blood-vessels in the common skin. In proportion as cicatrization proceeds, the granulations are removed by absorption, and the surface of the ulcer daily diminishes. At last, if the adjoining skin be not prevented by adhesions to the parts underneath, the cicatrix bears but a small proportion to the size of the original ulcer. We observe therefore, that when granular structure is prepared by the cessation of inflammation, that the mode of healing bears a strong resemblance to that which takes place when open wounds are cured without inflammation having occurred. Its chief difference consists in a certain quantity of the medium of lymph or granulation remaining, and being incorporated with the cicatrix."

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[1] Müller's Archiv. 1839, No. 3.

[1] Galen, Adversus Erasistrateos, cap. vii.

[2] Gueterbock, De Pure, p. 30.

[3] Müller's Archiv. 1839, No. 3.

[4] Treatise on Inflammation, p. 62.

Although cicatrization, as a general rule, proceeds from the circumference to the centre of a sore, yet there are particular instances in which it may also commence at several isolated points at the same time, and that chiefly in the instance of specific ulcers. "In such cases," says the last-named author[1], "the healing process is very rapid, and the granulations acquire their proper integuments, before there is time for their being diminished by absorption, or by their having assumed a plain surface." Under these circumstances, as might be expected, the cicatrix possesses a very irregular and puckered appearance, which is afterwards somewhat improved by the processes of contraction and absorption.

In the instance in which cicatrization occurs under a clot or scab, it is believed that it does not proceed from the edges, but takes place at the same time over the whole surface, as the covering is usually detached at once. In this mode of cure the cicatrix is supple, and most nearly resembles the common integument. It is quite incompatible with the process of inflammation, and is therefore only suitable to recent wounds which are kept perfectly at rest. It may be sometimes factitiously promoted in practice, by covering the broken surface with gold-beaters' skin.

There are certain conditions which favour, and others which retard or prevent cicatrization. To the former belong pure air, sound bodily health, and suitable regimen. Among the latter may be enumerated irritation, or inflammation of the adjunct structures, or a low pitch of their vitality; certain local circumstances, such as a varicose dilatation of the veins, position of the wound or sore over bone, presence of extraneous substances, caries; general morbid states of the system, from scrofula, herpes, syphilis. Carcinoma, without doubt, one of the greatest obstacles to cicatrization, does not always prevent it; since I have occasionally witnessed the fact of cancerous ulcers partly healing.

When the surface of the sore becomes dry, and its margins are hard and insensible, or preternaturally hot, moist warmth must be resorted to, as that which is effected by emollient poultices. If there be much heat and tension, a few leeches may be advantageously applied in the neighbourhood. When the granulations are too luxuriant, astringents are indicated, such as nitrate of silver, sulphate of copper, and burnt alum; the last will be found very efficient in counteracting the disposition to form bands, and the like. Should, on the other hand, the surface present an indolent character, topical blistering will be found very beneficial in imparting a vigorous and healthy action to the sluggish capillaries. It is well ascertained, that the exhibition of a purgative occasionally, promotes very materially the healing process.

Bibliography.—*Von der Kolk*, Comment. de regen. partium mollium in Vulnere, Göttingen, 1787; *Bichat*, Anatomie Générale, tom. i. p. 88; *Cruveilhier*, Essai sur l'Anatomie Pathologique, Paris, 1816, tom. ii. p. 164; *Delpech*, Chir. Clinique, tom. ii; *Pauli*, Commentatio physiologico-chirurgica de Vulneribus sanandis, Goetingæ, 1825; *Gueterbock*, De Pure et Granulatione, Berolini, 1837.

(*Alexander Ure.*)

CILIA, the Eyelashes, inversion of. See Trichiasis.

CINCHONA, *Quinquina*, Fr.; *Fieberrinde*, Ger. The pharmacopœial name of several kinds of Peruvian barks.

The use of this medicine was but little known until the year 1635, when a signal cure having been performed by it on the Spanish viceroy's lady, the Countess del Cinchon, at Lima, it came into general use, and hence it was distinguished by the appellations of cortex cinchonæ, and pulvis comitissæ, or the Countess's powder. The trees which afford the different varieties of cinchona grow wild in the hilly and mountainous districts of Peru, and on the Western Andes; the bark is stripped from the branches, trunk, and root, in September, and dried.

Three kinds of bark are now in use:—

1st, Heart leaved cinchona, (*Cortex cinchonæ cordifoliæ.*)—The bark of this tree is called the *yellow bark*, as it approaches nearer to that colour than either of the others. It is in flat pieces, not convoluted like pale, nor dark coloured like the red bark; it is smooth externally, internally of a light cinnamon colour, friable, and fibrous; has no peculiar odour different from the others, but has a much more bitter taste, with some degree of astringency. It is from this variety of cinchona that the alkali *quina*, has been obtained; which, in combination with sulphuric acid, forms the sulphate of quinine, now so extensively used.

2d, Lance-leaved cinchona, (*Cortex cinchonæ lancifoliæ.*)—This is the *quilled* bark, which comes in small quilled twigs, breaking close and smooth, friable between the teeth, covered with a rough coat of a brownish colour, internally smooth, and of a light brown; its taste is bitter, and slightly astringent; flavour slightly aromatic with some degree of mustiness.

3d, Oblong-leaved cinchona, (*Cortex cinchonæ oblongifoliæ.*)—This is the red bark of the pharmacopœia; it is in large thick pieces, externally covered with a brown rugged coat, internally more smooth and compact, but fibrous; colour, dark red; taste and smell, similar to that of the *lance-leaved cinchona*, but the taste rather stronger. The first variety is that which is most frequently used.

Few drugs have been more abused than this. When administered with judgment and discrimination, cinchona is a powerful agent in restoring lost tone to the system, in all cases of debility, however induced; and in imparting fresh energy and vigour to constitutions, congenitally weak. Even when a healthy state of the digestive organs exists, it imparts a higher power of action, promotes the appetite, assists digestion and nutrition, and gives a greater degree of regularity to the functions. The salutary effects of its administration, in cases of erysipelas, gangrene, old ulcers, extensive suppuration, and venereal ulceration, have been long and well attested, so also has the decided control it seems to possess over all diseases assuming a periodic character.

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[1] Ibidem, p. 63

Sir Benjamin Brodie relates the case of a gentleman, who had lived long in a tropical climate, and became affected with stricture of the urethra, of a spasmodic nature, which recurred every alternate night about twelve o'clock, and continued until five or six o'clock in the morning. By anticipating the paroxysms, and administering *quinine*, in large doses, at short intervals of time, a cure was effected.

The surgical diseases, however, for the cure of which cinchona derives its chief celebrity, are gangrene and mortification. Its great remedial powers in checking, and even subduing one of these morbid conditions, have gained for it, from Mr. Pott, the appellation of a noble medicine. That great surgeon observes, "Its general power of stopping the one (gangrene) and resisting the other (mortification) have made no inconsiderable addition to the chirurgic art." He excludes from this observation, that particular species of mortification of the toes and feet, frequently but erroneously attributed to the cutting the nails, or a corn, too deeply, and which he considers as being a disease, *sui generis*. Mr. Pott observes, in all other cases, wherein it is used, or recommended, no man has a higher opinion of it; but in this I cannot give it a praise which it does not deserve. The remedial effects of this medicine in mortification have, however, been questioned by another surgeon of eminence, Mr. S. Sharpe, who observes, "I have never clearly to my satisfaction, met with any evident proofs of its preference to the cordial medicine, usually prescribed;" and the learned author of the Surgical Dictionary seems to entertain similar doubts of its efficacy in the sáme disease. But, opposed to these opinions, we have the high authority of John Hunter, who has remarked in his observations on the mortification preceded by inflammation, that bark is the only medicine that can be depended on, as it increases the powers of the system, and strengthens the constitution, while it lessens the action.

Its first employment in these diseases is generally ascribed to Sir Hans Sloane, but Dr. Sigmond, in his interesting lectures on cinchona, says that the individual who published the earliest account of this practice was Rushworth, in a work, entitled, "A Proposal for the Improvement of Surgery;" he seemed, however, to be only aware of its value in the gangrene attendant upon intermittent fever. Douglas, Amyand, Monro, Kirkland, Van Swieten, De Haen, and Haller, have advocated the use of the bark.

It has been remarked, that tanners, and even individuals of delicate constitution living in the vicinity of tan-yards, derive benefit from the exhalations arising from the large quantities of the common oak bark employed in the process of tanning: and in illustration of its power of changing diseased into healthful action, and restoring vigour and energy to the enfeebled frame, instances have been cited of the speedy recovery of labourers working in tan-holes, whose health had been previously much impaired by old indolent ulcers, and diseases of a chronic character.

Notwithstanding all these testimonials in favour of the good results derivable from the judicious administration of Peruvian bark, we must not lose sight of the injurious effects contingent upon the wholesale and indiscriminate use of that powerful remedy. Some years ago, physicians and surgeons imagined that, in certain diseases, they could not administer too much bark, and measured the beneficial effects likely to result from the drug, according to the *quantity* taken by the patient.

With such disregard to the common principles of physiology and of pathology; and with the blind zeal of credulous enthusiasts, who, never thinking it necessary to institute inquiries of their own, allowed themselves to be carried along with the current opinion of the day, as to the *omnipotent* power of bark in subduing disease, is it to be wondered at, for it cannot be denied, that pernicious consequences have resulted from such an empirical *modus medendi?* We are aware that the remedial powers of bark have been greatly exaggerated, and that the drug itself has been greatly abused, in surgical as well as medical practice; but still, we confess that we do not see much reason at the present date for the horror, with which a contemporary surgical writer of high standing, seems to regard even the possibility of administering too large, or inordinate doses, of cinchona.

In prescribing bark, it is essentially necessary that the following circumstances be duly attended to:—

1st. In all cases where the stomach and intestines are in an irritable condition, or where the functions of the liver are deranged, it should not be administered. 2d. It should never be ordered until all inflammatory symptoms have subsided, or have been subdued by bleeding and other means. 3d. The influence which the administration of that medicine appears to exert on the digestive organs, and their several functions, should be carefully observed.

The officinal preparations of Cinchona are a subtle powder, an infusion, a decoction, tinctures, and extracts; besides the sulphates of Cinchonia and of Quinia. The usual dose of the powder is half a drachm, which may be frequently repeated. It was formerly given in much larger doses; Cullen gave as much as four drachms at a dose, when he wished the medicine to have a powerful effect; but the bulk of the dose alone was sufficient to nauseate. According to the opinion of Dr. A. T. Thomson, the best vehicle for administering it is milk, which effectually covers the flavour of the bark, if the dose be swallowed the instant it is mixed with the milk. It may also be administered in wine, in any spirituous liquor, or, if it excites nausea, combined with an aromatic. The cold infusion is the least powerful of the preparations of bark, but the most grateful. The decoction contains much more of the active matter, and is the preparation generally used when the powder is rejected; its dose is from one to three or four ounces. The spirituous tincture, though containing still more of the bark, cannot be extensively used on account of the menstruum; but is principally employed in small doses of two or three drachms, as a stomachic. The extract is a preparation of considerable power, when properly prepared, and is adapted to those cases where the remedy requires to be continued for some time. It is given in the form of pill in doses of from five to fifteen grains. Bark is also occasionally prescribed in the form of enema; one scruple of the extract, or two drachms of the powder, being diffused in four ounces of starch mucilage. The decoction is sometimes applied as a fomentation to ulcers.

The remedial effects of the barks depend on their alkaloids; their other principles exert either no energy, or a secondary influence merely. For instance, the kinic acid exerts a secondary influence by increasing the solubility of the Cinchonia and Quinia[1]. See Cinchonine.

CINCHONINE, *Cinchonia*, so called because it is obtained from *Cinchona* bark. Cinchonine is the salifiable base, or alkali, discovered in the *Cinchona Condiminæa*, or pale bark, by Pelletier and Caventou. Quinine being that which is found in the yellow bark, or *Cinchona Cordifolia*. The sulphate of Cinchonine, which is readily formed by the direct union of sulphuric acid and pure Cinchonia, has been little used, owing to the superior properties of the Sulphate of Quinine. The febrifuge virtues of Cinchonine have, however, been considered by some writers as very great. The solutions of both these salts are decomposed and precipitated by the infusion of galls, and all vegetable infusions containing gallic acid. The great advantage to be derived from substituting these alkaloids for the bark itself, is, that all the properties of the medicine are concentrated in a small compass; a large quantity of inert matter is avoided; and in cases where the stomach is irritable, and large quantities of bark would be rejected, they might be taken in sufficient doses to arrest disease.

The Sulphate of Quinine has, since its first introduction, been used largely as a substitute for the other forms of bark. It has been also employed externally by the endermic method.

(*Thomas H. Burgess.*)

CINNABAR, ARTIFICIAL, *Hydrargyri Sulphuretum Rubrum.* An artificial compound of mercury and sulphur, called factitious Cinnabar, red Sulphuret of Mercury, and Vermillion. It is employed in surgery for fumigating venereal ulcers, and obstinate cutaneous affections. The powder is placed upon a heated iron, and the vapour is conducted by means of a tube to the affected part. The following is the process according to which it is directed to be made:—

Take of mercury two pounds, sulphur five ounces; mix the mercury with the sulphur, melted over the fire, and as soon as the mass swells, remove the vessel from the fire, and cover it closely, to prevent the contents from igniting; then rub the powder, and sublime. This salt of mercury is, however, considered inferior to the *grey* oxide as a remedial agent in venereal affections, and is now rarely employed, except in some empirical nostrums, in which it forms the principal ingredient.

CIRCUMCISION. *Circumcisio*: from *Circumcido*, to cut round; *Beschneidung*, Ger. The operation by which sound or diseased prepuce is removed, by cutting instruments, so as to uncover, partially or completely, the glans penis. This operation is of very high antiquity. Amongst the Egyptians of old, and the Mahometans of the present day, it is resorted to as a prophylactic against the mischiefs arising in warm climates from the secretions rendered impure and irritating by being retained between the prepuce and glands. Amongst the Jews it was adopted as a religious characteristic.

Surgically, circumcision is indicated—1st. When the opening of the prepuce is so small, as is sometimes observed in children, that the flow of the urine is obstructed, and the prepuce itself is swelled out in the form of a bag. In such a case, circumcision is preferable to simple slitting of the foreskin, as the divided parts seldom retract sufficiently. 2d. When the tissue of the prepuce has been transformed into hard knotty masses, which press and confine the glans so as to render erection and coition extremely painful. 3d. In phymosis, whether congenital or accidental. 4th. In scirrhous enlargement of the glans penis itself, when the prepuce is removed in order to ascertain its condition; and, 5th. When the glans and prepuce have become enlarged and indurated from previous inflammation.

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[1] For much valuable information on this subject, see the Elements of Materia Medica and Therapeutics, by Dr. A. T. Thomson, and also Dr. Sigmond's Lectures on Cinchona, published in the Lancet for 1837.

The operation is performed thus:—The surgeon takes hold of the prepuce with a pair of forceps, as much of the part being left out, as he thinks necessary to be removed. With a single sweep of the knife, which, directed by the blades of the forceps, prevents any irregularity or unevenness of the incision, he will be enabled to remove the prepuce. Or it may be performed, as directed by M. Ricord, the prepuce being seized between two pairs of forceps, between which the incision is made.

In the Jewish mode of circumcision, the child is laid on a man's lap in a convenient posture. The operator takes the prepuce between the forefinger and thumb of the left-hand, and, drawing it forward, encloses it between the blades of a forceps-shaped spatula, then, raising the penis to a vertical position, he cuts off the prepuce, at one stroke, close to the blades of the forceps by means of a probe-pointed knife. He now, with the utmost rapidity, applies his thumb-nail, which is cut in a peculiar form for the purpose, to the inner fold of the prepuce, and lacerates it almost entirely down to the corona glandis. He then repeatedly washes the wound with water, projected upon it from his mouth, and sucks the blood from it several times. By way of dressing, a strip of soft linen is wound round the corona glandis; and the wounded parts are protected from all contact by a ring laid on the child's lap.

CIRSOPHTHALMIA, *κιρσος, varix; οφθαλμος, oculus—varicositas oculi.* The state of the eye to which this name is given is the consequence of choroiditis. It is synonymous with staphyloma of the sclerotica and choroid, and staphyloma of the ciliary body. See STAPHYLOMA.

CLAVUS, *the head of a nail*, a name formerly given to prolapsus of the iris through an opening in the cornea, when the protruding portion of the iris was flat, and but little elevated above the surface of the cornea.

CLUB-FOOT. *Varus, valgus, pes equinus, talipes or talus*, Lat.; *pied bot*, Fr.; *Klumpfuss*, Germ. The designation under which all deformities of the foot have been indiscriminately included. The word talipes having been adopted, by several late writers on the subject, as the generic term for the deformity in question, it will be employed synonymously with club-foot in the following pages, restricting the application of both terms to the general distortion as hereafter defined.

Four species or varieties of this deformity have been described, and designated as follows: *talipes varus*, distortion of the foot inwards; *t. valgus*, eversion of the foot; *t. equinus*, forced extension; and *t. calcaneus* or *talus*, extreme flexion of the foot upon the leg.

The investigation and establishment, by Dr. Stromeyer of Hanover, of the correct ætiology of club-foot, his successful revival of the operation of Thilenius for its cure, and the practical bearing of the same principles on other defects and distortions of the frame (see Spinal distortion, Strabismus, and Wry-neck), have given this subject a greater importance in the eyes of the profession, than almost any recent improvement in surgery, and have excited very general surprise that the treatment of these deformities should have been so long abandoned to the mere mechanic[1]. A review of the opinions entertained by successive writers upon this branch of surgery, will show that scarcely any addition to our knowledge of the nature and treatment of these affections was made from the time of Hippocrates to the latter part of the last century (1784), when Lorenz, a surgeon at Frankfort, divided the tendo achillis for the cure of a case of club-foot, under the direction of Thilenius[2]. The commonly received impression was, that they were the result of original monstrosity; and the cure was attempted according to the principle recommended and practised by Hippocrates, the gradual restoration of the natural form of the foot by mechanical pressure; each succeeding writer contenting himself with the suggestion of some new method of applying the principle, some new bandage or instrument.

On the other hand, few surgical improvements illustrate more forcibly the dependence of practical surgery on anatomical research and just physiological principles. Stromeyer's immediate predecessors, particularly Scarpa and Delpech, had thrown much light upon the nature of these affections; but sufficient obscurity still remained to check the repetition by others of Delpech's not very successful experiments[3]. An investigation into the influence of the respiratory system of nerves in producing disorder of certain muscles of the trunk, and thus occasioning curvature of the spine[1], led Dr. Stromeyer through the secondary to the primary sources of club-foot, exposed its real nature, and enabled him to lay down the true system of treating it with so much certainty and amplitude, that succeeding writers have done little more than confirm the principles, for the development of which we are indebted to him.

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[1] When we consider the numbers daily presented to our notice suffering under this infliction, the singular circumstance that two of the greatest poets and the first diplomatist of the day, Byron, Scott, and Talleyrand, were thus afflicted, and contrast the severity of the misfortune with the facility of cure by the proceeding of Stromeyer: it does appear extraordinary, that more correct views of the nature of club-foot, which could alone lead to a more successful method of treatment, should not have been worked out earlier.

Lord Byron's sensitiveness with regard to his deformity is well known. Many of his peculiarities as a writer have been traced to this source of misery. To escape from it he would have made almost any sacrifice. Sir Walter Scott bore the privation with a better grace. His exultation in his superiority to the companions of his boyhood, in feats of daring and activity, is familiar to the readers of his Life by Lockhart. With what satisfaction, too, he records the prowess of his club-footed ancestor, William the Bolt-foot.

Timour Beg, (surnamed Timour Lenc, or the lame,) the conqueror of Western Asia, is an illustrious instance of great achievements accomplished by a cripple. He was lame not only of a foot, but of a hand. Such examples almost make good Lord Bacon's position: "Whosoever hath any thing fixed in his person that doth induce contempt, hath also a perpetual spur in himself to rescue and deliver himself from scorn; so that upon the matter, in a great wit, deformity is an advantage to rising."—Essay Iv.

[2] Medicinische und chirurgische Bemerkungen von Moritz Gerhard Thilenius.—Frankfort, 1789.

[3] As recently as 1830, amputation has been resorted to, to relieve a patient from the distressing circum-

A brief notice of the various opinions held by those who preceded him is called for in justice to them; and will further serve to elucidate the steps by which we have arrived at a more scientific and successful method of treating these hitherto neglected affections.

The scope of this article will not, however, be confined to the new surgical treatment; it will likewise embrace a notice of the mechanical means by which the same object may sometimes be attained, and a consideration of the circumstances which should influence us in selecting one or the other mode of treatment.

I. THE NATURE AND CAUSES OF CLUB-FOOT.

Its *nature*.—Till within a recent period, club-foot was supposed to originate and consist in mal-formation of the bones of the tarsus, more particularly of the astragalus, the result either of primitive monstrosity or of morbid changes in the bony structure, as from rickets. From a mere external inspection of feet thus distorted, it would naturally be surmised, that imperfection or unnatural formation of the bones themselves was the cause of the deformity. The extreme predominance of congenital instances of talipes, over those in which it is acquired in after-life, would lead to the further conclusion that such defective formation was original.

This opinion, more or less modified, was maintained by Glisson, Camper, Blumenbach, Colles, and Cruveilhier; and an anatomical examination of talipes in subjects at a late, or even at an adult period of life, would appear to warrant the conclusion. Such was likewise the persuasion of Delpech in his first publication on club-foot[2], although he subsequently found reason to abandon the idea. The consequences of the prevalence of such an opinion were most serious. It necessarily followed that, excepting during the very earliest stage of existence, the deformity must be regarded as incurable. Scarpa[3], whose attention was directed to this distortion in infants, ascertained that the bones themselves exhibited very slight deviations from their natural forms: displacement, in a greater or less degree, "a rotation on their axes," of the os-calcis, os-scaphoides, and os-cuboides existed; but he asserts, that, of the four tarsal bones, the astragalus, so far from being the chief cause of the deformity, presented the least alteration both of form and position, being invariably more or less completely situated within the articular cavity formed by the tibia and fibula.

Mackeever[1] and Palletta[2], who, like Scarpa, met with opportunities of examining the anatomical characters of club-foot soon after birth, drew a similar conclusion, namely, that the departure from the natural condition resulted rather from displacement than from primitive mal-formation of the bones. Tourtual[3] carried back his researches to a still earlier period. His report of the dissection of the distorted feet of a seven months' acephalous fœtus, substantiates the main point detected by the three former writers—the simple malposition, originally, of the tarsal bones. Dr. Little's observation of the anatomical condition of the foot in talipes (see figs. 171[4]) agrees generally with the account given by Scarpa; therefore, notwithstanding the opposing authority of Cruveilhier, whose minute investigation of the morbid anatomy of club-foot will claim our notice in a future division of the subject, we may venture to affirm, that the opinions, relative to the nature of these distortions, of the majority of those writers who have considered the matter pathologically, concur in the following points: That although more or less deviation from the natural form of the bones of the tarsus may generally be detected, and does, in some few instances, constitute a spurious variety of the deformity, displacement of these bones, more particularly of their articular facets, invariably exists, and must be regarded as the distinguishing feature of genuine club-foot.

The morbid changes which have been observed in talipes will be more fully considered hereafter.

Causes of the distortion.—On this point a great variety of opinions has prevailed. That alteration of the relative position and connexion of the tarsal bones, which, according to the evidence adduced, appears to be the real nature of club-foot, has been supposed by some writers to originate in arrest of the natural development of the foot, in consequence of undue compression of the fœtal limbs by the uterus. Von Walther has even

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stances attending this deformity. Dr. Stromeyer was present at the operation, performed at Hamburg during the meeting of the German Association of Naturalists, and states, that it was sanctioned by some of the first surgeons in Germany.—Beiträge zur operativen Orthopädik, p. 60.

[1] Ueber Paralyse der Inspirations Muskeln.—Hannover, 1836.

[2] Chirurgie Clinique de Montpelier, 1823.

[3] Memoria Chirurgica sui Piedi torti.—Pavia, 1803. Translated by Weisheart of Edinburgh.

[1] Edinburgh Med. Journal, vol. xvi. p. 220. 1820.

[2] Exercitationes pathologicæ, p. 138. Mediol. 1820.

[3] Zweiter anatomische Bericht.—Münster, 1832.

[4] These figures are copied, with the author's permission, from Dr. Little's "Treatise on Club-foot, and Analogous Distortions." Dr. Little was himself the subject of a congenital club-foot, for the cure of which, Dr. Stromeyer divided the tendo-achillis in 1836. See his case related by himself in his Thesis "Symbolæ ad talipedem varum cognoscendum," and by Stromeyer, "Beiträge zur operativen Orthopädik." p. 83.

contended[1], that "talipes varus is a natural grade of the development of the foot, since embryos of three or four months old frequently *retain* one or both feet in this state." This view of the matter is founded upon his very peculiar theory of embryo development[2]; and he labours ingeniously to explain how those feet which go through the proper stages of development are converted from the state of varus, to that perfect form which they ought to present at birth. Von Walther's theory is not confirmed by the researches of others in embryology, and, even were it established, and his explanation by it of the origin of varus and pes equinus admitted, its application, as Dr. Little observes, to valgus, is decidedly inadmissible.

Cruveilhier, although he maintained that congenital club-foot was caused by an unnatural form of the tarsal bones, and chiefly of the astragalus, existing prior to their ossification, combated the notion of its production by uterine pressure; alleging, as sufficient evidence to the contrary, the birth of infants affected with talipes, during whose uterine existence there had been no deficiency of the liquor amnii, and that of well-formed infants where scantiness of liquor amnii had been noticed. Common experience, in fact, contradicts the notion, that compression exercised by the uterus itself, and applied externally, in order to conceal pregnancy, for instance, is often a direct cause of deformity. Nevertheless, being still disposed to trace a mechanical agency in its production, Cruveilhier became convinced that both club-foot and club-hand arise from an impediment to development, resulting (not from uterine pressure, but) from the limbs being arranged in improper positions in relation to each other and to the trunk. Duval, who differs widely from Cruveilhier in his views of the nature and origin of the deformity, is inclined to admit, that it may occasionally, though rarely, be thus produced; and the experience of Boyer and Guerin leads them to express the same opinion. An assertion relative to club-hand, adduced by Cruveilhier in support of his opinion, is refuted by Dr. Little. He affirms that the carpus being composed of small bones, and its articulations very loose, (the reverse of the ginglymoid articulation of the ankle,) no deformity of the hand analogous to talipes varus could occur, as the fœtal distortion of the carpus and metacarpus disappears after birth, the removal of the pressure causing their return to the natural form and position. The inaccuracy of this statement of the spontaneous disappearance of club-hand after birth proves, says Dr. Little, the fallacy of the inference. Dr. Little refers to preparations of this double deformity in the Berlin Museum, which disprove Cruveilhier's assertion, and relates two cases which had fallen under his observation, in which congenital distortion of both feet and hands existed in an extreme degree at an adult age. "Had Cruveilhier," proceeds Dr. Little, "witnessed a case of club-hand in the living subject, he would not have asserted that this affection is spontaneously remedied after birth. Club-hand suggests many important reflections, being precisely analogous to talipes varus." (See art. CLUB-HAND.)

The co-existence of club-foot in both limbs, which has been cited in favour of the opinion that it is caused by uterine pressure, leads merely to the inference of one common disturbing cause; and this common cause, as will presently be shown, having been ascertained and established on better evidence, the mechanical explanation falls to the ground.

By others the origin of the distortion has been sought in the unnatural contraction of one and elongation of another set of ligaments. Hippocrates believed this to be one of the "manifold" causes of club-foot. Scarpa, Mackeever, Cruveilhier, and others, determine the fact of the existence of this alteration in the relative proportion of the ligaments; but this must rather be regarded as an effect than as a cause of the deformity. "The ligaments," says Dr. Little, "cannot directly influence the production of the deformity, but its progress may be facilitated by their relaxation; the restoration of the foot is impeded by their diminished length, the result of long continuance in an improper position." The same observations apply to Maisonnabe's opinion, that talipes varus depends upon shortness of the plantar fascia.

The opinion which has obtained the most weighty support, both in numbers and authority, is, that these affections are the consequence of a disturbance of the balance between the flexor and extensor muscles of the foot.

Passing by the observation of Hippocrates[1], as being too obscurely worded to be decisive as to the precise ideas entertained by him on this point, we have in favour of this opinion, before the result of Stromeyer's investigation was made public, the names of Benjamin Bell, Duverney, Boyer, Jörg, Rudolphi, and Delpech in his second treatise. To this mass of authority we may now add the confirmatory experience of Stromeyer, Dieffenbach, Bouvier, Little, Duval, Guerin, and a crowd of contributors to the periodicals of the day, who have adopted the theoretical views of Stromeyer, and, with occasional modifications, have followed practically in his footsteps.

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[1] System der Chirurgie, B. i. p. 349.—Berlin, 1833.

[2] The formation of the hands and feet from a sort of bladder, by the rupture of which, and the separation of its margins, the edges of the foot are formed. See Dr. Little's Treatise, Introd. p. xiii.

[1] Vari igitur non uno modo sed pluribus fiunt. Plerumque siquidem non ex toto sede suâ elapso articulo, sed quod *re aliquâ* detentus eo habitu assuerit, pes varus efficitur.—Hippocrates, Lib. de articulis, sect. vi.

It is worthy of remark, that the subject of club-foot is treated of by the father of physic in connexion with dislocations, with the nature and management of which he was familiar. It is possible, therefore, that he might have contemplated muscular agency in the detaining force alluded to.

The reader will find a very clear and able analysis of the opinions of those writers who preceded him, in the introduction to Dr. Little's treatise already alluded to.

After showing the unanimity of B. Bell, Duverney, Boyer, and Jörg, in ascribing talipes to inequality of muscular action, "Rudolphi," says Dr. Little, "gave a more complete view of the origin than any of his predecessors, and one more consistent both with physiology and pathology. He concluded that congenital talipes and the analogous deformity of the hand (club-hand) arise from disordered influence of nerves on muscles in the fœtal state, by which their contraction is prematurely excited, and often in so vehement a manner, that the mother experiences pain from the convulsive motions; the limbs thus become distorted, and permanent deformity is often thereby occasioned. He observes, that the authors who have maintained the injurious influence of external and mechanical causes, such as pressure of the uterus through an improper position of the fœtus, appear to have been unaware, that these distortions are not unfrequently witnessed in embryos of three or four months. Rudolphi not only points out the influence exercised on the muscles of the extremities by powerful and general causes affecting the entire nervous system of the fœtus, but states that talipes often occurs in infants, in other respects well-formed, from simple spasm." To Delpech, however, belongs the merit of having first worked out and practically applied the correct principle of treating these affections. Although in his first publication[1] he advocated the opinion that club-foot originated in mal-formation of the bones, he agreed with Scarpa, that the muscles contributed materially to the increase of the deformity.

The observation of two cases of varus, occurring at an age when the bones had attained their full development, taught him, that the muscles were active agents in the production, as well as in expediting the progress, of these affections. The first case was one of injury to the external popliteal nerve, by a gun-shot wound in the thigh. The peronei, tibialis anticus, extensor longus digitorum, and extensor proprius pollicis muscles, became paralysed, and the unresisted contraction of their antagonists produced distortion of the foot inwards. In the second case, excessive contraction of the posterior muscles of the leg, succeeded to abscesses of the thigh and necrosis of the femur, the equilibrium between the flexor and extensor muscles of the foot was destroyed, and varus in an extreme degree ensued. In his treatise on this subject[2], published six years after the "Clinique," Delpech avows his change of opinion, shows that a disturbance of that "equilibration which is natural and necessary to all the muscles," is the immediate cause of these deformities[1], and that this may result not only from direct injury, as in the two cases noticed above, but from more remote influences, as from hydrocephalus, effusion upon the brain or spinal cord, or even from irritation excited in the nervous system during dentition. Yet Delpech still believed that the gastrocnemii were the only muscles involved in the production of talipes, that pes equinus was the first stage of the deformity, and that the inclination of the toes inwards or outwards gradually manifested itself, and was fully confirmed by pressure exercised in the act of walking.

Dr. Stromeyer[2] has collected, under the following heads, the various sources of distortion dependent upon irregular action of the muscles:—

1. Structural changes in the muscles, inflammation, and wounds, with loss of substance.

2. Debility and inactivity of antagonists, produced—

(*a.*) By wounds of tendons or of the bellies of antagonist muscles.

(*b.*) By paralysis of the nerves of the antagonist muscles; this may be complete or partial, and affect either the voluntary or involuntary motor powers.

3. Diminution of voluntary power in the entire limb, without paralysis of the sympathetic nerves, through which the flexors (in the foot the extensors) preponderate over the extensors (in the foot the flexors) by the constant organic contraction of the muscles.

4. Painful affections of the part, restraining or prohibiting motion, such as that from inflammation of a joint. In this instance also the extensors yield to the flexors.

5. Increased energy in the muscle, morbid contraction or motion in the muscular fibres—tonic spasm. The muscle, through constant contraction, becomes inert with reference to its particular function, but continues in a state of tension from its fibrous structure.

The causes enumerated under the first and fourth heads produce deformity, but not genuine talipes. Those included under the second, third, and fifth heads, are alone the sources of true club-foot.

Stromeyer considers the contraction of the muscles of the calf to be the essential cause of talipes equinus and t. varus, regarding the varieties presented by individual cases of varus as secondary phenomena. With Delpech and Cruveilhier, he is inclined to attribute the inversion in varus to defective formation of the malleolus internus[3]. Such a deficiency has not, however, been confirmed by the observation of others.

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[1] Chirurgie Clinique de Montpelier, 1823.

[2] De l'Orthomorphie, 1829.

[1] Delpech gives due credit to the late Mr. Shaw, for his suspicion that the loss of equilibrium in the muscles was a cause of deformity.—T. i. p. 83.

[2] Ueber Paralyse der Inspirations-Muskeln.

[3] In a recent private communication (June 25th, 1840) which I have received from Dr. Stromeyer, he observes, "the difference between congenital and non-congenital club-foot consists, 1st. In the *constantly spasmodic* nature of the former, while non-congenital club-foot more frequently originates in paralysis and unequal re-establishment of muscular power, or in tonic contraction of the predominant mass of muscles,

The opinions of MM. Guerin and Duval, and Dr. Little coincide, in the main, with the views of Stromeyer ; but they go beyond him in applying the principle above developed, inasmuch as they agree in ascribing all deformity actively produced, and superadded to simple retraction of the heel (talipes equinus), to the agency of other muscles affected by the same circumstances, which have given rise to unnatural action of the gastrocnemii.

Convinced that much light is thrown upon the nature and causes of congenital club-foot by a consideration of the circumstances under which it is acquired after birth, Dr. Little thus illustrates his opinion : " In the first place, we will take a case originating from paralysis of the *anterior* tibial muscles. Here the remote injury, the cause of paralysis, is the same as that of paralysis of other parts of the body ; namely, inflammation and the effusion of blood, or sero-sanguineous or serous fluid, in some part of the brain or spinal cord, which compresses or otherwise injures the delicate texture of that part of the nervous centre whence the affected muscles derive their nerves. The *posterior* muscles of the leg (those of the calf in particular) having lost their natural antagonists, become firmly and permanently contracted, by the constant action of their involuntary contractile power, by which the heel is raised from the ground, constituting talipes equinus. At an early period of the disease, this contraction may be overcome by forcibly bending the foot with the hand ; but this after a time becomes impossible.

" The other case, that of a talipes originating from spasm, admits of a different explanation. The remote cause resides either in the central organs of the nervous system (most probably in the spinal marrow), or it is a disease existing in some other organ of the body, affecting peripheral parts of the nervous system ; for instance, in some one of the viscera of the chest or abdomen, more probably of the latter. From this an injury is propagated to the central organ, and is reflected to certain muscles of the leg, which become spasmodically contracted. In other words, there may be either some deviation from the healthy state in a part of the spinal marrow, where the roots of the motor nerves distributed to the muscles of the calf are implicated or irritated, causing them to become involuntarily contracted ; or there may exist elsewhere some disease, such as an irritation of the mucous membrane of the alimentary canal by improper or undigested food or worms, through which filaments of nerves (named by Dr. Hall *incident*) are excited. These communicate in the spinal cord with other filaments—the *reflex*, or involuntary motor nerves, whereby the muscles of the calf are excited to spasmodic action.

" In this explanation of the production of a non-congenital talipes, I have confined myself to the most simple and intelligible form of the talipes equinus. The t. varus differs only in depending on paralysis or spasm of a larger number of muscles. When paralysis is the cause, the peronei muscles have lost their power, as well as the anterior tibial and long extensor muscles of the toes. If spasmodic contraction be the cause, the posterior tibial muscle, long flexor muscle of the great toe, those of the sole of the foot, and sometimes the tibialis anticus muscle, are partially involved in the production of the deformity.

" I have here defined the manner in which I consider talipes to arise after birth. Any cause, whether paralytic or spasmodic, by which the equilibrium between different sets of muscles, that are naturally antagonists, is disturbed, produces the distortion vulgarly called club-foot.

" Other causes, viz. those which produce a shortening of the muscles and other soft parts upon one side of the leg, by disturbing, although in a different manner, the antagonism of the muscles, are capable of producing deformities similar to those belonging to the genus talipes. I have had under my care two examples of the ankle-joint rigidly fixed in the extended position ; in one instance the heel having been raised three inches, and in the other from five to six inches, in consequence of the contraction of numerous cicatrices on the back of the leg, resulting from the healing of abscesses, accompanied with loss of substance through sloughing and necrosis. Another cause of the shortening of the muscles on the back of the leg arises from the long confinement of patients to bed, during the union of some kinds of fractures, or during the reparation of other injuries. I have also met with a case of permanent elevation of the heel produced by the ankle-joint having been too tightly secured by mechanical apparatus, and continued too long in the extended position, for the union of a ruptured tendo achillis. The contraction had also been increased by the patient having worn high-heeled shoes."

The last causes referred to produce only a spurious variety of the deformity.

" Having thus offered my opinions," continues Dr. Little, " of the causes of those deformities of the feet which take place after birth, and stated the identity of their symptoms and morbid anatomy with those of the club-foot with which children are born, the probability will, I think, appear obvious that the remote causes are the same : but there are other phenomena connected with the history of these affections which render the accuracy of these opinions almost capable of demonstration. Fœtuses which have suffered some evi-

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produced by external irritation, very different from the true spasmodic affection resulting from internal causes in the fœtus. 2nd. The form of acquired club-foot deviates less from pes equinus, because the irregularity of muscular action commences at a time when the malleoli and ligaments of the tibio-tarsal articulation are sufficiently developed to keep the foot under the axis of the tibia."

dent derangement in the development of the nervous system, such as those denominated hemicephalous and acephalous, or affected with spina bifida, and those born before the expiration of the natural period of utero-gestation, are particularly obnoxious to this deformity of the feet. The occurrence of the perfectly analogous deformity of the hands which takes place prior to birth, denominated club-hand, in which the flexors and pronators (analogous to the so-called extensors and adductors of the foot) are likewise contracted, corroborates the opinion that congenital club-foot depends on spasmodic muscular contraction. In the instances which I have examined of congenital deformity of the hand (club-hand), both in museums and in the living subject, the feet were also affected with talipes, proving the operation of a common cause."

We may assume it, therefore, as fairly established, that genuine club-foot, in all its varieties, is produced by irregular action of certain muscles, which irregular action consists in a disturbance of the balance existing naturally between the antagonising systems, the flexors and extensors, the adductors, and abductors of the foot; that this disturbance may occur in two ways: one system of muscles may be altogether deprived of nervous influence—may be paralysed, in short, and incapable of counterbalancing their antagonists in a state of *ordinary* action; or, retaining their ordinary power, the same set of muscles may be overcome by their antagonists preternaturally excited—in a state of *extraordinary* or spasmodic action; and, finally, that the occasional co-existence with congenital talipes of congenital club-hand[1], squinting, stammering, and spasmodic contractions throughout the muscular system, and the occurrence of club-foot as a consequence of convulsions during dentition, of fever, measles, croup, &c. in infants, of apoplexy,—or even of hysteria, in adults,—all indicate an origin dependent upon imperfect development or lesion, upon changes either of structure or function in the cerebro-spinal system, with scarcely less certainty than that with which many instances of acquired club-foot may be traced to direct local injury or irritation of a particular nerve.

II. *Morbid or abnormal changes in the state of the limb in Talipes.*

These changes are by no means uniform; they are modified by the variety of the deformity, and by a multitude of other circumstances. The following details are an enumeration of those abnormal deviations which have been most commonly noted: The entire limb generally presents an atrophied appearance; its temperature is often below the natural standard, and more or less œdema exists; in short, the vital powers of the limb are altogether diminished.

Morbid changes of *the Bones.*—The astragalus certainly exhibits the greatest deviation from its natural condition, but this rarely amounts to a change of form. It is, in general, a diminution of volume arising probably from the pressure to which certain parts of it have been submitted; and an alteration of surface, traceable to the change of position its articular facets have undergone, relatively with the other tarsal bones, and with the articular arch formed by the extremities of the tibia and fibula. In fig. 171, it is manifest, that this arch or trochlea embraces an entirely new articular surface of the astragalus, the original convex tibial facet being almost entirely denuded of its cartilage, and roughened. This is more or less the case in every variety of club-foot, the new facet being removed to a greater or less distance from its original site, according to the degree of flexion, extension, or rotation that the astragalus has been subjected to. The articular surface of the tibio-fibular trochlea is circumscribed and varied to a corresponding extent. The head of the astragalus is generally much reduced in volume, its scaphoidean articular facet much contracted in area, and its upper margin forms a prominent tuberosity on the dorsum pedis. The os scaphoides is also somewhat diminished in volume, but not altered in shape. Its inner margin occasionally acquires, in varus, an articular connexion with the internal malleolus, to which it becomes united by ligament. The calcaneum is seldom fully developed; its cuboidean articular facet is contracted in area; and in varus of long existence, an external tuberosity is formed at the point upon which the patient treads. The rest of the tarsal bones preserve their natural characters.

Fig. 171.

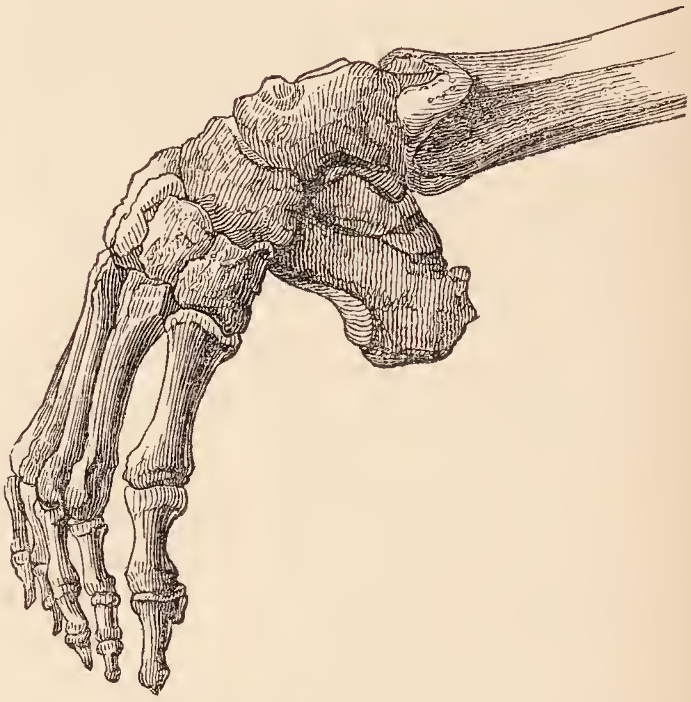

Fig. 171. *Disposition of the bones in pes equinus.*

The *ligaments* undergo changes corresponding with the altered position of the bones; but, according to Cruveilhier, their relaxation and contracture is not so extreme as was stated by Scarpa. In varus, the deltoid ligament of the ankle-joint becomes shortened, and a new band of fibres, or accidental ligament, is often found tying down the malleolus internus to the calcaneum ; the external lateral ligaments are lengthened. To a certain degree, the contrary must take place in valgus. The capsular ligament is stretched anteriorly, posteriorly, or laterally, according to the variety of the deformity. In the case of extreme varus, the anatomical examination of which is recorded by M. Holtz of Strasburg[1], a vacancy existed between the astragalus and calcaneum, filled with fibrous and ligamentous matter, which contributed much to maintain the unnatural position that the astragalus had acquired. The plantar (inferior calcaneo-scaphoidean) ligament was shortened, and tended also to keep up the mal-position. The remaining ligaments presented very slight deviations from the natural state, with the exception of the superior calcaneo-cuboid ligament, which, in accordance with Scarpa's observation, was very much lengthened.

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[1] See the case figured by Cruveilhier, Anat. Path. liv. ii. pl. 2.

The plantar aponeurosis, to the contracture of which Maisonnabe ascribed the origin of club-foot, was found, by Cruveilhier, to have lost, in common with the other aponeuroses and fasciæ of the foot and leg, the firm dense structure which ought to characterize it. It had become " singularly thinned," offered no obstacle to the extension of the toes, and its transverse division did not in the least facilitate the restoration of the displaced bones. This may have been the case in the instances examined by Cruveilhier ; but subsequent observations have demonstrated that it does frequently materially impede our efforts to reduce the bones to their natural situations, and that, in these cases, much is gained by a transverse division of its fibres.

The *muscles* and *tendons* display considerable deviations from their normal condition. One set of muscles is found to be more lengthened, their antagonists shorter than natural. The tendons, as represented in fig. 172, in passing over the foot, are drawn out of their ordinary course, and some of those which, at first, resisted the production of the deformity, may, in their new position, assist in increasing it. The muscular tissue itself is generally in a state of atrophy, shrunk both in length and bulk ; its fibres are sometimes converted into a kind of fatty matter, but this fatty degeneration, Dr. Little states, is very rare. The tendons are usually more slender than ordinary, and appear disproportionately long. There are cases, however, where some of the muscles, the gastrocnemii for instance, are spasmodically contracted into a firm ball, as in cramp ; and their tendon (Achilles) is thicker and stronger than natural.

Fig. 172.

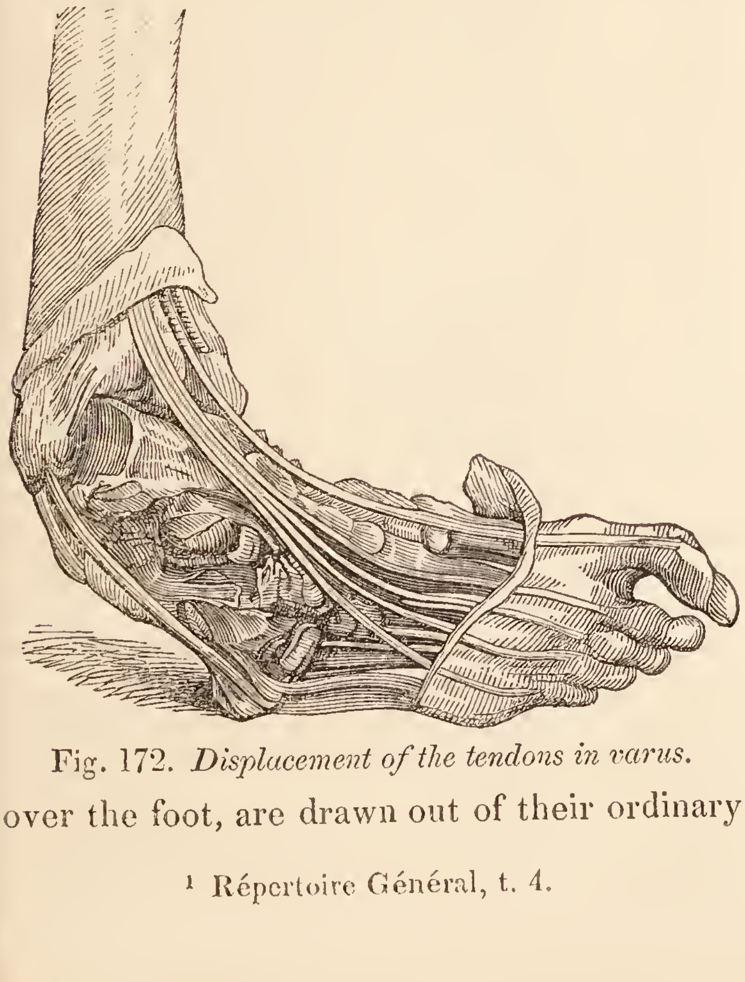

Fig. 172. *Displacement of the tendons in varus.*

The *blood-vessels* are much dwindled in size ; in an adult case Cruveilhier was unable to inject the muscular arteries.

The *nerves*, also, supplying the muscles in this subject were shrunk, and reduced to little more than their neurilema.

Finally, at those points where the distorted foot rests upon the ground, a synovial capsule is frequently developed beneath the skin, which, at this point, is rough and horny ; whilst the skin of the sole, not having been subject to pressure, is unusually thin and delicate.

The morbid conditions above enumerated, belong to the three first varieties of talipes. In t. calcaneus, or talus, fig. 173, the result of contraction of the tibialis anticus, and extensor digitorum, the bones are displaced in a direction precisely opposite to that which is presented by a case of talipes equinus.

Fig. 173.

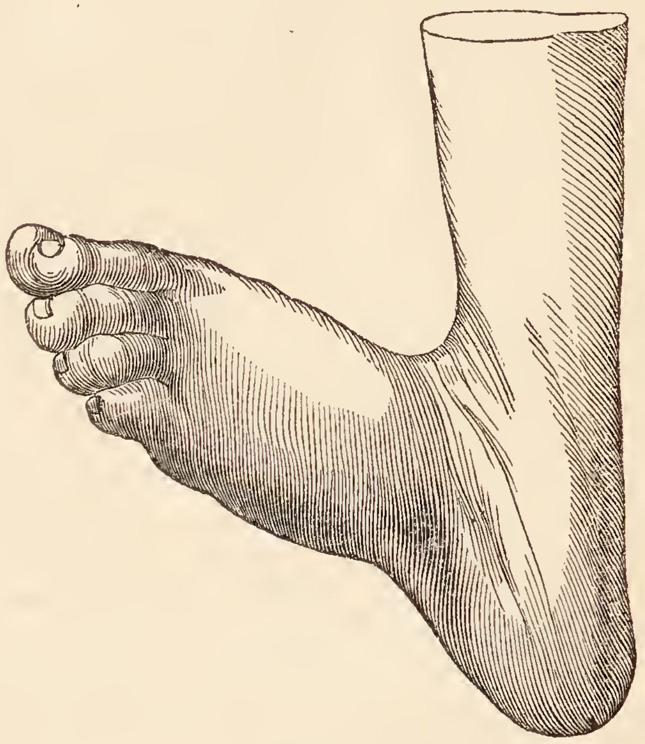

Fig. 173. *Talipes calcaneus.*

III. *Treatment of Club-foot.*

1. By mechanical means.
2. By division of the tendons of those muscles which, by their contraction, have caused the distortion ; and completing the restoration of the foot to its natural position by mechanical adjuncts.

Before we resort to either of the methods

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[1] Répertoire Général, t. 4.

of treatment just specified, the circumstances of the case should be minutely investigated, especially with reference to the origin of the deformity, as this may suggest important modifications of the treatment. When the disturbance of the equilibrium of the muscles is a consequence of paralysis of the anterior muscles of the leg, if there is any ground for suspecting that the cause of the paralysis is still in action, attention must be directed to the central organs of the nervous system, and the case must be treated as one of simple paralysis. In the purely spasmodic affection of the muscles we must also endeavour to ascertain whether any of the remoter sources of irritation, already alluded to, are in operation; since the medical treatment calculated to relieve that derangement of function, whether of the nervous system, of the digestive apparatus, or any other organ, which has given rise to the mischief, may, at the same time, remove the deformity, or, at any rate, dispose it to yield more readily to mechanical resources. Dr. Little's three instructive cases, xxv., xxvi., and xxvii. forcibly illustrate the practical importance of this preliminary scrutiny.

1st. The *mechanical* treatment.

Whether or not Hippocrates, as some have supposed, contemplated the cure of club-foot by the section of tendons, there can be no doubt that he treated these deformities successfully by bandaging[1]. Our hopes of success, however, by this method must always be restricted to the earlier stages of the affection: when the deformity has been confirmed by time, no effectual amendment can be expected from the application of bandages. More powerful mechanical aid has, therefore, been sought in the adaptation of a variety of apparatus to this object, composed wholly of leather or pasteboard, or of leather strengthened by metallic plates, bars, or springs.

Plaster of Paris has been made use of for this purpose with some degree of success. In cases where the deviation from the natural standard is but slight in degree, and requires but moderate force to overcome it, as during the early period of congenital club-foot, the deformity may be wholly rectified by means of plaster of Paris, or even by the use of bandages steeped in a solution of dextrine, starch, or any of the pastes employed of late in the new method of treating fractures[2]. (See Art. Fracture.) MM. Velpeau, Guerin, Dr. Dieffenbach, and others, have published favourable reports of the efficacy of the plaster of Paris treatment. The following is Dr. Dieffenbach's method of proceeding[1]. Having prepared a box for the reception of the foot and leg, well oiled over its inner surface, he places the limb, also well oiled, within it. Fluid gypsum is then poured over it, and the foot is retained, by the hand, in a position as nearly as possible approaching the natural form, until the gypsum is sufficiently hardened to maintain it. In three weeks or a month, as soon as the foot has acquired a better form, another plan is adopted: the foot being enveloped by straps of adhesive plaster, a roller is applied, and a diluted mixture of the plaster of Paris is spread over it with a brush; when dry, a second coat is applied, and this is repeated three or four times, to give the whole a considerable degree of solidity. On the day following, the surface is varnished over with a solution of resin in spirit of wine (in the proportion of ʒj to ℥j), and in this state it may remain, without inconvenience, for months. If pain should be complained of, a portion of the bandage may be cut away, and any vesication or excoriation healed without detaching the entire case.

In selecting cases adapted to this method of treatment, we must be guided by the degree to which the foot can be approximated to its natural form: if much flexibility exists, and the surgeon is consulted at an early period, a successful issue may be confidently predicted. If the distortion is great, and the tarsal bones yield but little to the application of force, should an operation be objected to by the friends of the patient, we must resort to more powerful mechanical means for accomplishing our object.

A great variety of machines have been invented for this purpose, many of them derived from the ingenuity of non-professional mechanics. Those devised by Scarpa, Colles, Delpech, Graefe, Langenbeck, Heine, Delacroix, &c. are exceptions; but, till within the last few years, it has been the practice of surgeons, both in this country and on the continent, to turn over such cases to the care of the mechanic, and leave the patient entirely in his hands.

The apparatus, fig. 174, applied by Dr. Little *after* division of the tendons in varus, is a modification for the better of Scarpa's boot. Dr. Colles employed a leather shoe with a pair of tin splints attached to it. Langenbeck's machine for the cure of pes equinus is very similar to that used by Stromeyer, (fig. 175,) *after* division of the tendo achillis. Fig. 176 is Delacroix's instrument; his power of extension was obtained by means of a gun-spring, constantly acting by a chain and rack upon the tendo achillis. Delacroix, likewise, brought the weight of the body to act powerfully in extending the tendon, by placing the feet of his patient in a pair of stocks, or narrow boxes screwed upon a board supported by a couple of rocking feet. By daily exercising the contracted muscles in this manner, he gradually

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[1] Atque hæc quidem curatio, quæ neque sectionem neque ustionem, neque aliam varietatem ullo modo postulat. Ista namque opinione celerius curationi cedunt. Tempore tamen superanda sunt, quoad justo habitu corporis incrementum acceperit. Hippocrates De Articulis, sect. vi.

[2] In his observations, appended to Gataker's translation of Le Dran, Cheselden speaks of having successfully treated Club-foot and fractures by enveloping the limb in a bandage dipped in a mixture of flour and white of eggs, p. 452.

[1] See Caspar's Wochenschrift für die gesammte Heilkunde.

Fig. 174.

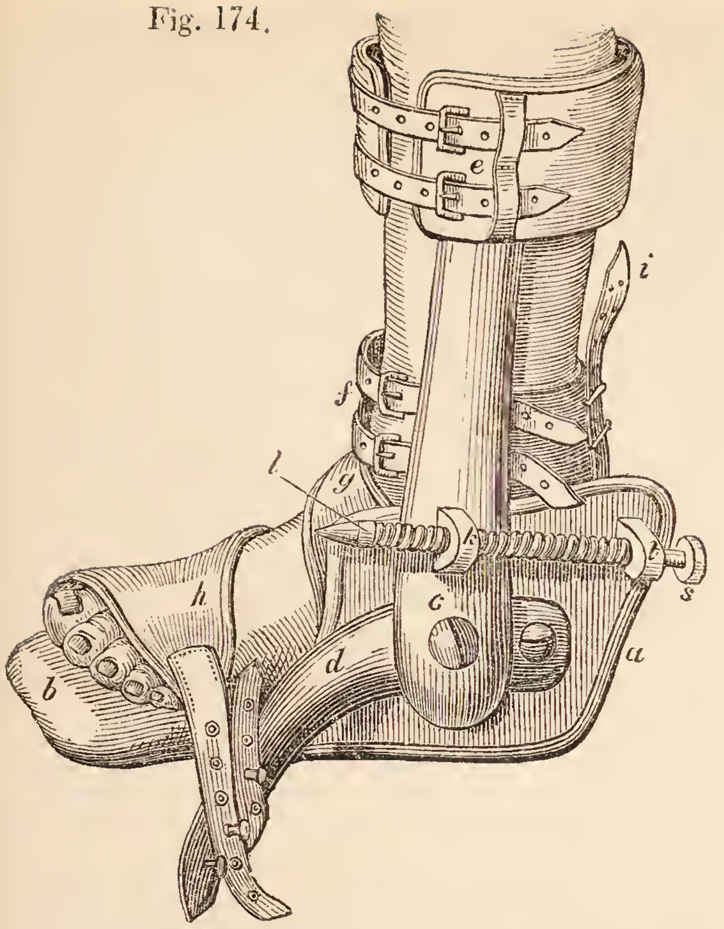


Fig. 174. *Dr. Little's Boot. The letters a and b designate a shoe formed of iron, covered with leather, and well padded with horse-hair: c is a steel spring, which, by means of the padded strap c, is worn upon the outside of the leg; i and f show a strap and bandage to go round the ankle, by which the heel is held securely in the shoe. The straps g g hold the heel firmly towards the inside of the shoe, whilst the short spring d draws the toes and front of the foot outwards, by means of the padded strap h passed round it. The screw l, which moves through a female screw k, (itself fixed as a rotatory rivet to the spring c,) acts upon the ankle-joint, and enables the surgeon to bend it as rapidly or as gradually as he may please.*

Fig. 175.

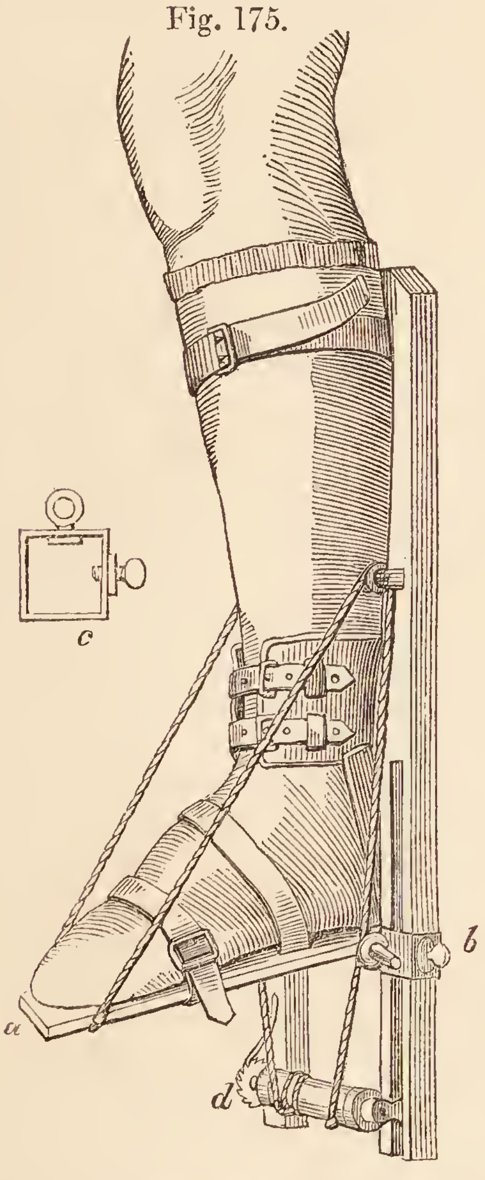


Fig. 175. *Stromeyer's instrument.*

Fig. 176.

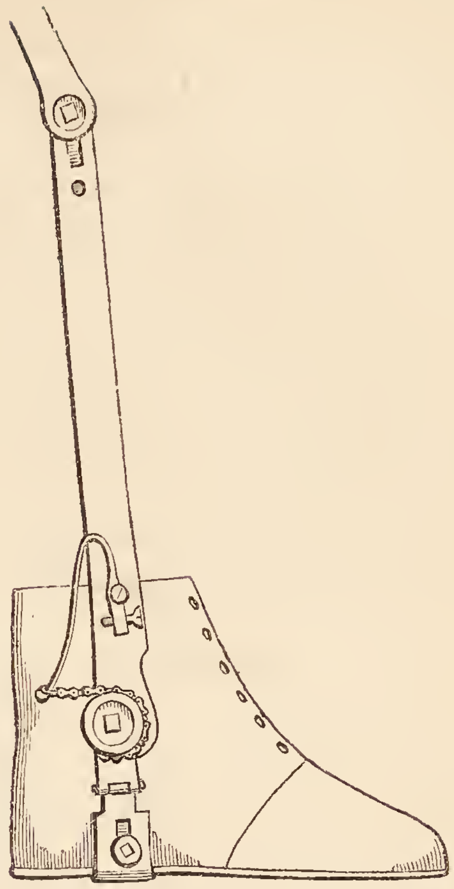


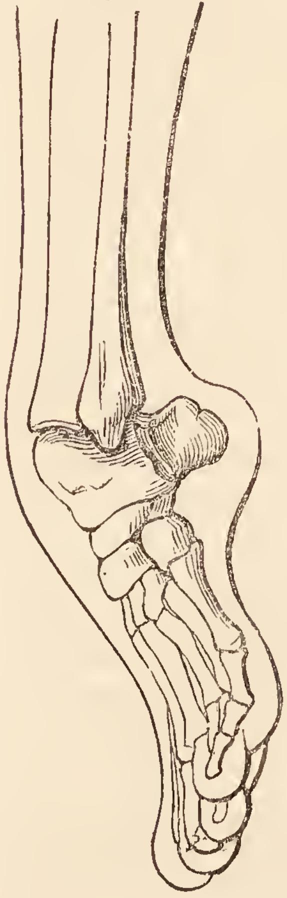
Fig. 176. *Delacroix's instrument.*

restored their healthy action and the flexibility of the ankle and tarsal joints. An exceedingly ingenious instrument, in which, also, the requisite power is obtained by the agency of a gun-spring, has been invented by Charles Eagland, son of the late instrument-maker at Leeds. He has given a full description of it in a paper published in the *Lancet* for 1838. Having myself employed Eagland's machine, and witnessed its successful operation in cases of varus, I can testify that it is calculated to fulfil the necessary indications.

The mechanical treatment, however, which was founded on the justest principles, and which appears to have been attended by great success, is that pursued by the late Timothy Sheldrake, of which a full account was published by him in the *Lancet*, for 1827-28, vol. xiv.

The following extract, from a paper in the number for July 26th, 1828, will show how nearly the views entertained by Sheldrake of the nature and cause of the deformity correspond with its true ætiology, as developed by the labours of Scarpa, Tourtual, and, Stromeyer: "There were three deviations from the natural state of the parts in these limbs, which, though they were united to produce the deformity, must be considered, as they were treated, separately: first, a deviation from a natural arrangement of the bones (Fig. 177); this was the

Fig. 177.



basis of the deformity, although the bones were quite passive; second, a peculiarity in the capsular ligaments, which will hereafter be explained; and, third, a deranged action of the muscles, which was the direct cause of all the distortion."

Reasoning upon the information contained in Captain Turner's account of his embassy to Thibet, relative to the mode by which the withered limbs of religious enthusiasts, who have voluntarily abstained from the use of them for years, can be made to recover their natural powers, and applying Mr. Hunter's principle for the restoration of debilitated muscles, Sheldrake proceeded as follows:—"I placed," he says, "upon the leg, a plate (B, fig. 178,) of iron, tin, or other metal, as the circumstances of the case required; this was lined, or otherwise guarded, so as to prevent its edges, or any other part from pressing upon any part of the leg. This contrivance, by whatever name it is called, was fixed to the legs by straps, bandages, or adhesive plaster, arranged in any manner that at the moment seemed to be necessary. Upon this plate I fixed a spring, whose length was equal to, and, when circumstances required it, longer than the greatest length of the leg and foot, the curve of which was directly contrary to the bend that the foot had taken, and the range of whose action was, if it had been exerted to its fullest extent, such that it would have drawn the foot at first to its natural position, and afterwards much beyond it. This perhaps may be understood by reference to the annexed figures, which represent the deformed foot and leg; the curved line, *a a*, fig. 178, represents the curved spring.

Fig. 178.

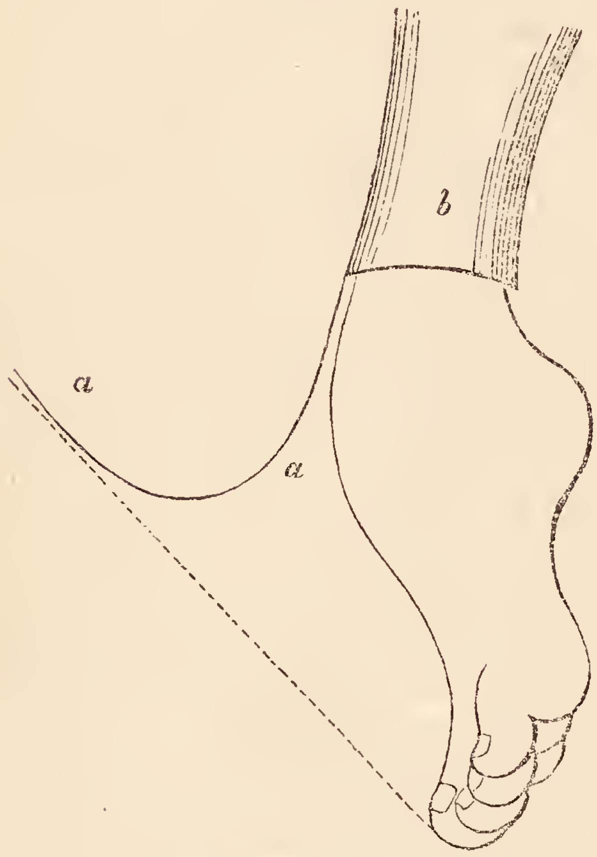


Fig. 178. *Sheldrake's apparatus.*

"I assumed at first that the deformed state of the limb was produced by contraction, or retraction of all the flexor muscles of the leg, and, in this case, a small degree of contraction in the plantar aponeurosis; by these means the action of the extensor muscles was first overcome, and afterwards lost. The leading idea that I adopted was to produce contrivances that should imitate the action of those muscles which had lost their power, and then, by applying them in a proper manner, overcome the too powerful contractile action of the flexors; if this were done, and the loss of power in the extensors were but temporary, the natural action of the whole limb would be restored; but, if the loss of power in the extensors were permanent, after the foot was restored to its natural form, it would still be necessary to support it by artificial means, to prevent it from relapsing, and enable the patient to walk, though in a manner that would necessarily be imperfect.

"This part of my process may be described in few words; but to practise it with success requires great and unwearied attention for a long time. I have always proceeded in this manner: first, to ascertain the degree of rigidity that exists in the contracted limb, and the degree of force that must be used to counteract it. Having determined these two points, with as much accuracy as the circumstances will allow, and prepared my springs accordingly, I apply and fix the upper part of the instrument to the leg; I then try, with my hands, how far I can raise the foot towards its natural position; I hold it firmly in that position while I bend the end of the curved spring down towards the foot, and bind it, by passing straps of adhesive plaster round the spring and round the foot, so that, when left at liberty, the reaction of the spring will draw the foot upwards, towards its natural position, something more than I can draw it with my hands. The effect of this is, that the foot is drawn upwards, and the muscles which are subjected to this action, are strained to a certain extent; it is the nature of all muscles that are drawn to their full extent to endeavour to retract; in doing so, those muscles upon which I operate are checked by the springs, totally, if the spring is too strong; but if it is of a proper strength, it will be overcome by the reaction of the muscle. But, as no muscle can continue in one action long, and the elastic action of the spring is continued, it follows, of course, that when the strength of the muscle gives way, the spring overcomes, and draws the muscle to itself, and, having yielded until its tendency to retract predominates, it again overcomes the action of the spring, and they thus proceed alternately till the cure is complete. I hope that I shall be understood, as this is the best explanation I can give: my meaning is, that in healthy muscular action, action and reaction are equal and opposite to each other; but in these distorted feet, one of the actions is first diminished till it is quite lost, and the foot becomes rigidly fixed. When the remedy is applied, and brought into action, the power of the extensors, which has been lost, is supplied by the artificial contrivance that has been described; it is increased gradually till it overcomes the contraction of the gastrocnemii muscles; the bones are restored to their natural situation with respect to each other; and the patient is enabled to set his feet flat upon the ground; this may be called the first stage of the cure.

"The progress of the alteration in the gastrocnemii muscles took place nearly in this manner:—On the first application, the muscles were extended as much as they would admit; they were then in a state of tension; when the spring was put in action, more tension was produced; after a short time there was pain, increased circulation, and a tendency to inflammation. When this took place, the action of the spring was diminished, till that tendency disappeared, and the spring again brought into action; this was so managed, that, after it was once brought into action, the extending power never ceased till the patients were able to stand flat on their feet; this, in the three cases related[1], occupied about eight months in each case; in that time the gastrocnemii muscles were lengthened more than four inches, and increased in bulk to the extent that has been described"

The second stage of the cure includes the restoration of the lengthened extensors, stretched ligaments, and redundant skin to their natural proportions. To effect this, continued pressure was employed. "I contrived an instrument, which, when placed upon the foot, prevented it from passing in any way from the position in which it was when the patient stood upright upon it; when this was done, I made compresses of soft materials, but of so much firmness, that they would keep the form I had given to them. These compresses were made of forms that would allow them to press the soft parts close to the bones; these soft parts were guarded with a sedative plaster, to prevent any irritation of the skin; the compresses were then carefully applied in their proper situations, and, over the whole, a tight bandage in the nature of a laced stocking, which was always laced as tight as possible."

Manipulation of the limb was afterwards continued for some time, entirely to restore the natural action of the muscles; and many examples of the success of this method are given in other papers. Mr. Sheldrake applied the same principles to the treatment of every variety of true club-foot, adapting his springs, so that they might act distinctly upon those muscles, the contraction of which was the source of the distortion.

However rational the principle on which it is conducted, the mechanical treatment alone must, at best, be tedious and uncertain in its results, and should only now be resorted to in slight cases, soon after birth, or where the objections to an operation by the patient and friends are insuperable.

Valuable hints for the management of those cases, *after* division of the tendons, may, nevertheless, be derived from the details of the mechanical treatment. A steady and active perseverance in warm bathing, friction, and manipulation, will alone do much to restore contracted muscles to their natural condition.

M. Holtz, in the paper cited[1], records an instance, in which the re-establishment of the equilibrium of the muscles, in a case of congenital varus, was effected simply by great attention and efforts on the part of the boy himself, unaided by mechanical means. He took the greatest pains, in walking, to plant the sole of the foot firmly on the ground; and as he was in the habit of carrying heavy weights, the cure was thus accomplished before he reached the age of twelve years.

2. *Treatment of Club-Foot by section of the tendons of contracted muscles, and completing the cure by mechanical agency.*—Until within the last few years, the wounding or division of a tendon was regarded as an occurrence likely to be attended by very serious consequences. It is now fully demonstrated that the mischief occasionally resulting from such an accident is an effect of other causes superadded to the injury inflicted on the tendon. It may be ascribed with much more justice to the lesion or exposure to which the sheath of the tendon, or the cellular tissue in which it is imbedded, is subjected. Suppuration and sloughing of the cellular tissue, implicating more or less the tendon and its sheath, may certainly take place after section or rupture of the tendo achillis. Such was the case in several of the early instances in which the tendo achillis was divided for the relief of club-foot. Delpech's operation[2] may be cited as an example strongly illustrating this. When unaccompanied by injury to the surrounding parts, and judiciously treated, a divided or even a ruptured tendon speedily unites, and no evil consequences ensue.

Direct union does not take place between the extremities of a divided tendon.

"The surrounding cellular membrane," says Mr. Mayo[3], "is thickened by an infiltration of coagulable lymph, which forms a bed that contains and adheres to the divided ends. This bed of thickened membrane shapes itself into a callus, which coheres inseparably with the ends of the tendon, and acquiring strength and firmness after a time, shrinks to the size of the neighbouring tendon, and assumes its white colour and fibrous character." The experiments performed by Von Ammon upon dogs and horses, and the observations of Zeis and Bouvier, confirm Mr. Mayo's statement. Von Ammon found that a considerable separation of the divided extremities of the tendon did not prevent a solid and perfect reunion, but the process was under such circumstances more tedious. (See TENDON.)

The first recorded attempt to cure club-foot by section of the tendo achillis is that related by Thilenius (1784) already referred to. Sartorius and Michaelis some years afterwards followed the example of Thilenius, but their operations were imperfectly conceived, and rather calculated to throw discredit on the practice. Sartorius employed so much violence to bring down the heel immediately after dividing the tendon, that he lacerated the ligaments, and excited a high degree of inflammation, the consequence of which was ankylosis of the ancle joint. Michaelis endeavoured to weaken the tendon by cutting through one third only of its substance, and then resorting to force to reduce the foot to its natural position. By this proceeding he must have incurred great risk of giving rise to suppuration and sloughing of the tendon, and inflammation of the joint, and could only have effected his object by rupturing the undivided portion of the tendon. We cannot wonder, therefore, that Michaelis had no imitators, and that such an operation was soon abandoned.

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[1] Lancet, vol. xiv. pp. 271. 361. 406.

[1] Répertoire Général, t. iv.

[2] De l'Orthomorphie, t. ii. s. 327.

[3] Outlines of Human Pathology, p. 120.

The merit of working out the true nature of club-foot, of laying down sounder principles for treating it, and especially of having endeavoured to establish the Thilenian operation on the basis of those principles, is justly due to Delpech. Having observed the mode of union of divided tendons, he conceived the idea of effecting a cure after division by a gradual extension of the uniting medium before it had acquired much firmness. He carried his views into practice by dividing the tendo achillis in a case of pes equinus in the year 1816. The attempt proved successful, but owing to the unnecessary extent of the wound and the disturbance of the surrounding tissue, in consequence of the foot having been immediately brought to the natural position, in order to satisfy himself that the obstacle had been overcome, suppuration and sloughing supervened, and its ultimate restoration was not accomplished till some months had elapsed. It is surprising that so favourable a result was at length obtained, since extension was not commenced till a month after section was performed, the wounds being even then uncicatrized. This attempt was ridiculed by Cruveilhier; and neither by Delpech, nor by any other surgeon, was the operation repeated till it was performed by Stromeyer in 1831.

Like Delpech, Stromeyer pursued his investigations in a scientific spirit. He detected the errors of his predecessors, and laid down rules for avoiding them, deduced from theoretical reasoning confirmed by experience. In 1833 and 1834 he published two memoirs containing the histories of six successful cases. His views were, after some little opposition, adopted and practically tested by many continental surgeons: the practice was early and successfully introduced into this country, and Dr. Stromeyer has now the satisfaction of seeing it universally established without any essential modification of the method at first laid down by him. Stromeyer's rules are, first, by a puncture of the skin and a subcutaneous division of the tendon, exposure of the tendon and its sheath is avoided, and the danger of inflammation is consequently lessened; secondly, he considers that it is unadvisable to commence the restoration of the foot until the external wound is completely cicatrised; the contrary proceeding being often followed by inflammation and suppuration. Nor is early extension necessary, since the recovery by the muscle of its normal sphere of action is not so much the result of the gradual mechanical extension applied subsequently to the healing of the wound, as the effect of the stimulus to its contractility afforded by the motions of the limb during exercise after complete reunion of the tendon.

Mr. Whipple, of Plymouth, and M. Bouvier, both recommend extension of the foot to be commenced immediately after the section of the tendon, alleging that the process is more painful when deferred till the wound is healed. "This assertion," says Stromeyer, "is entirely imaginary, as the pain thus produced is never referred by the patient to the divided part, but to other tissues still resisting the extension, the tibialis posticus and peronæi muscles, and the posterior ligaments of the joint[1]."

By far the majority of operators have adopted the views and follow the practice of Stromeyer, the various improvements suggested having reference to the form of knife, the distance from the heel at which section should be performed, and the mode of dividing the tendon, whether from behind forwards, or the reverse, whether by a transverse or oblique section. "There has indeed," as Dr. Little remarks[2], "been no improvement of the principles laid down by Delpech, the value of which was first satisfactorily demonstrated and practically illustrated and enforced by Stromeyer. But there has been a departure from these principles, which Stromeyer has justly designated a retrograde process."

The shape of the knife employed for the division of the tendo achillis is a point of little moment, provided that it accomplishes the essential rule of severing the tendon by means of a puncture, with the least possible disturbance of the surrounding parts. For performing section of the tendon of the tibialis posticus, Dr. Little recommends a stouter blade, to guard against the possibility of the point being broken in the wound. At the end of his treatise, Dr. Little has added the figures of five knives employed by him in operating. A narrow-bladed common scalpel, or small straight bistoury, will answer every purpose in the hands of a surgeon of ordinary dexterity. The point at which the section of the achilles tendon should be performed must be regulated by the degree of elevation of the heel and the prominence of the tendon, It is in general most conveniently accomplished at the distance of about an inch from its insertion into the os calcis. By Dr. Little and the most experienced orthopædic surgeons a preference is given to the transverse section from before backwards. "The proposition," says Dr. Little, "to divide the tendon in an oblique direction, in order that larger surfaces may be presented for the effusion of the uniting medium, and firmer reunion of the tendon be ensured, has resulted rather from mechanical ideas of the mode of reunion of divided tendons than from practical observation or physiological reasoning. I have invariably performed the transverse division, and in every instance the tendo achillis has united by a band as firm and large, and sometimes even larger, than the original tendon; the spot where the operation has been performed is frequently imperceptible. The experiments of Von Ammon, Günther, and Bouvier on dogs and horses have demonstrated that reunion of tendons, by a strong ligamentous or semi-cartilaginous band, takes place, in whatever manner the division be effected, and whether the ends be maintained in apposition or at a distance, resulting from contraction of the muscle, or even when portions are removed." Division of the tendo achillis is only calculated to relieve effectually talipes equinus and the slighter cases of varus[1]. In aggravated cases of varus and valgus we are compelled to divide the tendons of other muscles besides the achilles tendon. In varus, the tendons of the tibialis posticus, flexor longus pollicis, and sometimes of the tibialis anticus, require division. Yet this extensive application of the knife must not be hastily decided on. Very extreme instances of varus, especially when originating in paralysis of the anterior muscles of the leg, may be cured by section of the Achilles tendon alone. Of this, Dr. Little's 22d case is a marked example. In valgus, division of the tendons of the peronæi muscles is necessary, in addition to that of the tendo achillis.

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[1] Beiträge zur operativen Orthopädik, p. 17.

[2] Treatise on Club-foot and analogous Distortions, Introduction, p. lx.

Whenever the section of other tendons besides the achilles tendon is required, it is better to divide the tendons of those muscles which produce the inversion or eversion first; and, having brought the foot in line with the leg, that is, having reduced the deformity to the state of talipes equinus, then to operate upon the tendo achillis.

Not unfrequently before the contraction can be fully overcome, a transverse section of the plantar fascia is called for.

After-treatment.—In whatever way the section of tendons for the relief of distortions may be performed, the success of the operation depends mainly upon the after-treatment pursued; and this refers not merely to the form of apparatus employed in the mechanical extension of the tendon and the foot, a process which, in the more complicated varieties of talipes, has afforded scope for the exercise of much ingenuity. It includes also the active manipulation of the foot and leg, with the object of elongating the contracted ligaments, restoring the natural relative position of the bones, and exciting the long-suspended contractility of the muscles. To accomplish this satisfactorily within the limited period during which the divided tendon can be extended, requires, in the majority of cases, great labour and attention. Assiduous manipulation with the hand, aided by the relaxing influence of hot bathing and friction, is indispensable. This treatment must be commenced as soon as the divided extremities of the tendon are sufficiently united to admit of it; three or four days may in general be allowed for this result, although a tolerably firm adhesion will frequently take place in the course of twenty-four hours. The mechanical extension and the manipulation must be moderate in degree at first, and increased gradually as the tendon is found capable of bearing it. During the first fortnight of the after-treatment, the manipulation and hot bathing must be actively carried on for at least half an hour twice in the day, and the extending apparatus reapplied, and its action increased after each operation. About a fortnight after the division of the tendon, if the progress of the case permit it, the patient may be allowed to bear upon the limb, and by degrees encouraged to walk, his attention being directed to the maintenance of the proper position of the foot, and particularly to the planting of the sole firmly upon the ground. This will be found materially to contribute to the complete restoration of the foot. Nevertheless, even when conducted with the greatest care and attention, the treatment may fail; a single operation may not suffice to bring down the heel and rectify entirely the mal-position. The surgeon may be baffled by the extreme contraction and strength of the ligaments, which will only partially yield whilst the tendon continues extensible. In such a case a repetition of the section will be necessary to complete the cure. This is a point to be taken into consideration in giving a prognosis, otherwise the patient and friends may be disappointed, and discredit will be thrown upon the operation. In one case Dr. Dieffenbach divided the tendo achillis six times before he obtained a satisfactory result.

A great variety of apparatus has been suggested in order to effect the mechanical extension of the foot after the tendon has been divided. In proportion as the case recedes from the simplicity of talipes equinus, more complicated apparatus becomes necessary, and the surgeon has a larger field for the exercise of his mechanical invention. The instrument of Stromeyer (fig. 175) will be found sufficient to bring down the heel after the section of the tendo Achillis in the simpler forms of distortion. That employed by Dr. Little (fig. 174) accomplishes more than Stromeyer's machine; it is adapted to effect the extension of the heel and the eversion of the foot at the same time. In the more aggravated cases of varus, where the tendons of the adductor muscles, as well as the tendo achillis, require division, Dr. Little recommends the section to be performed at different periods; he divides, in the first instance, the tendons of those muscles which produce the eversion, and applies the splint represented at fig. 179 to bring the foot to a right line with the leg; after which the case is treated as simple pes equinus. After the division of the tendons of the peronei muscles for the cure of valgus, a boot furnished with a curved spring, the convexity of which is applied to the inside of the leg, so that it will act in a direction opposite to the distortion, is sufficient to rectify the eversion.

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[1] Stromeyer, in his early practice, attempted the cure of every variety of club-foot by section of the tendo achillis alone, and frequently with perfect success. In the letter to the author of this article, already referred to (p. 785), he writes, "My opinions on club-foot are very little altered since the publication of my Beiträge. I am, however, no longer doubtful of the necessity of dividing the tendon of the tibialis posticus, having repeatedly done it with decided advantage."

Fig. 179.

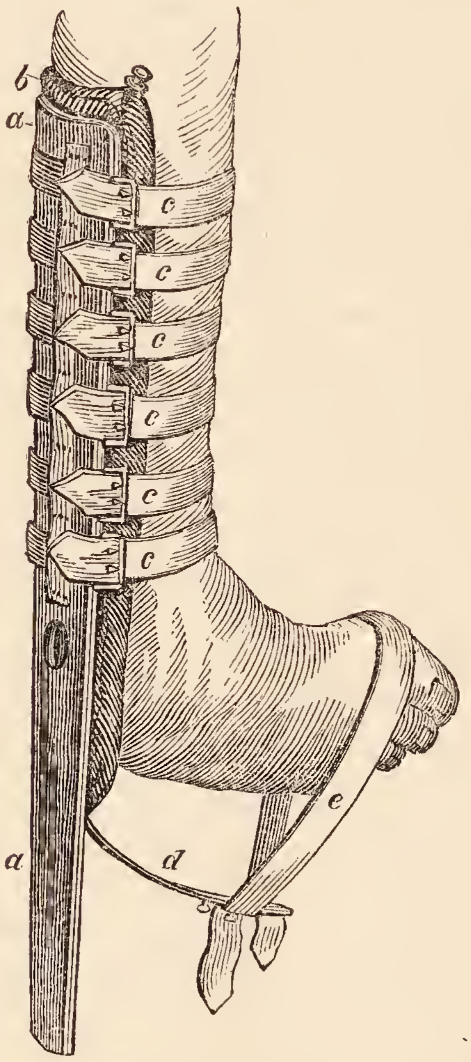

Fig. 179. *Dr. Little's Splint for effecting eversion in a case of varus.*

The points on which a correct *diagnosis* of cases suited to the operation depends, may be gathered from what has been said under the head Nature of Club-foot, bearing in mind the characteristics of genuine talipes laid down by Stromeyer. Contracture, however, arising from the causes enumerated under the 1st, 2d, subdivision *a*, and 4th heads laid down by Stromeyer, (see p. 784,) although it does not constitute genuine club-foot, may frequently be much relieved, sometimes cured, by the section of the tendons implicated in keeping it up.

A *prognosis*, favourable or unfavourable to the operation, must be founded on the degree of mal-formation resulting from long-continued mal-position; on the amount of flexibility or contraction of the ligaments, the excess of which last complication, if not discovered till after the section of the tendons, may entirely frustrate that operation; on the existence or non-existence of paralysis; and on the degree of contractile power still existing in the contracted muscles. The following cases[1] will tend to illustrate the principles I have endeavoured to develop:—

"1. *Talipes equinus, originating in paralysis of the anterior muscles of the leg.* —— Ennalls, ætat. 8, a healthy boy, whose right heel has been gradually drawn up since he recovered from a fever four years ago. The instep and dorsum pedis are now, February 20th, 1838, in a right line with the front of the leg. No inversion or eversion of the foot. He walks upon the bent toes of that foot. The muscles of the calf become extremely rigid as soon as extension of the heel is attempted, and a portion of the mass corresponding with the situation of the soleus is contracted into a hard fibrous knot. By bending the knee considerably, and employing force, the foot can be approximated somewhat towards its natural position. On directing the patient to attempt to draw up the foot and extend the toes, no action of the tibialis anticus can be detected, and the contraction of the long extensor of the toes is so slight as to be scarcely perceptible. This observation led me to give a cautious prognosis as to the degree of power which the muscles might recover when the foot was restored to its proper position, as the origin of the deformity seemed to be traceable to paralysis of the tibialis anticus muscle.

"March 8. The achilles tendon was divided by a simple puncture through the skin, and a splint applied along the front of the tibia and dorsum of the foot, to maintain the mal-position for the present, and prevent too much retraction of the divided extremities of the tendon.

"11. Removing the splint, I gave the foot gentle passive motion, and ascertained, by its action on the calf, that tolerably firm adhesion between the divided ends of the tendon already existed.

"On the 12th a simple extending instrument was applied, and in three weeks from this time the foot was brought to a less angle than a right angle with the leg, and the patient was able to walk half a mile with great ease. Owing to the powerless condition of the extensor muscles, he was obliged to throw his foot forward in walking, in order to apply the sole to the ground; and no improvement in this particular had taken place when I saw him some months afterwards.

"2. *Varus complicated with retraction of the heel.*—The history of the case is as follows:—H. C. Esq., ætat. 29, a graduate of Cambridge, and student at the bar, was attacked in the winter of 1822-3 (an. ætat. 13) with symptoms indicative of inflammation or irritation of the lower part of the spinal chord, which terminated, in the course of a few weeks, in paralysis of the bladder and *right* lower extremity. After a confinement of six months, the limb partially recovered its muscular power, but has continued weak and shrunk in size to the present time. About a year and a half after the commencement of the disease, at which time he had recovered much of his former activity, he noticed that the toes of the *left* foot were becoming slightly inverted, and that the heel appeared to be a little drawn up. This inversion of the toes and retraction of the heel increased gradually till the year 1827, when the deformity was so great, that counteracting measures could no longer be dispensed with. Callam's instrument was first employed, and the patient was afterwards placed under the care of Mr. Chessher, of Hinkley. Scarcely any advance towards rectifying the deformity was made under the use of Mr. Chessher's machine, nor did it much facilitate his power of progression. In fact the distortion, of which fig. 180 is a sketch, has been slowly increasing in both directions up to the date of his application to me, and the irons have lately been far more injurious than beneficial in their action.

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[1] From a paper on the Pathology and Treatment of Club-foot, by the writer of this article, published in the Lancet, vol. ii. 1839, May 25.

Fig. 180.

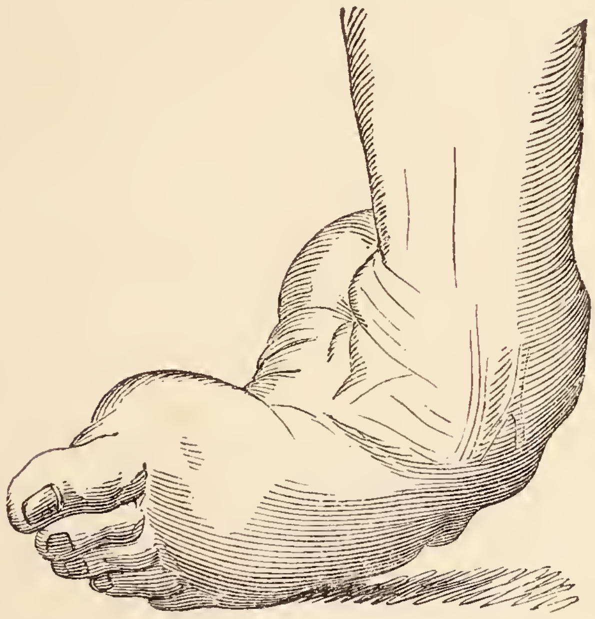

Fig. 180. *Aggravated case of t. varus.*

"The case being less promising than any that had yet come under my notice, before I decided on operating, I requested my friend, Dr. Little, to examine the foot with me. He expressed himself in terms by no means sanguine as to the result of the operation, and counselled a very guarded prognosis, telling the patient that he must be satisfied with any degree of improvement that might follow.

"Adopting Dr. Little's practice in varus attended by retraction of the heel, namely, attempting first to straighten the foot, and leaving the heel to be brought down afterwards, I proceeded to operate, with the former intention, on the 23d of August. The muscles whose contraction occasioned the inversion of the toes, were the flexor longus pollicis, the adductor pollicis, and the tibialis anticus[1], the plantar fascia being also shorter than natural, and very tensely stretched at every attempt to straighten the foot. The tendons of the flexor longus and adductor pollicis were reached without difficulty by a short incision along the inner margin of the sole, a little anterior to the malleolus internus, and both were divided with the point of a straight bistoury. I then passed the bistoury between the skin of the sole and the plantar fascia, and turning its edge towards the latter, divided it as I withdrew the blade. Section of the tendon of the tibialis anticus was readily accomplished by gliding the point of a curved bistoury beneath it. Having satisfied myself, by a very cautious extension, that no other obstruction to the return of the foot to its natural position remained, I applied a splint along its dorsal surface, and directed the limb to be kept in a state of perfect quiet.

"Aug. 25. Removing the splint, I everted the foot slightly, and gently moved the ankle and tarsal joints for a short time, and on the 26th commenced more powerful extension by means of a straight splint, employed by Dr. Little, to the inside of which, at its lower end, a strong spring is attached. (See fig. 179.) The upper part of the splint is confined to the outside of the leg by a bandage, and the foot being secured by a loop to a stud at the end of the spring, as great a degree of eversion as it can bear is kept up by the action of the spring, the loop being shortened daily as the toes yield. The pressure on the outside of the foot occasioned some troublesome vesication and superficial sloughing, which retarded our progress somewhat; but early in October I was able to take the cast, (fig. 180,) representing the state of the foot six weeks after the first operation; in short, reduced to a talipes equinus.

Fig. 181.

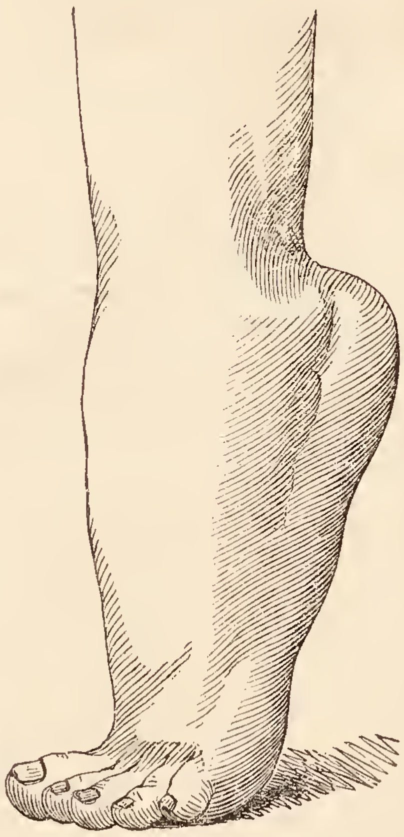

Fig. 181. *T. varus reduced by section of the adductor tendons to the state of pes equinus.*

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[1] "The tibialis anticus, which is a primary agent in producing valgus, has a secondary action also in some cases of varus. It is first extended considerably as the gastrocnemii draw up the heel, and again contracts when the inversion of the foot has reached a certain point, aiding the adductors in increasing the distortion, and sometimes preventing the return of the foot to its natural position when the tendons of these latter are divided."

"My patient then left town for a few weeks, and, having returned early in November, the achilles tendon was divided on the 6th. Perfect extension of the foot was maintained by a splint along its dorsal surface, and on the 10th adhesion of the divided ends of the tendon having already taken place, the extending instrument was applied. On the 21st the foot was brought up to a less angle than a right angle with the leg, the sole being well applied to the ground, and he began to bear the weight of the body upon it. He continued to exercise the limb daily, and on Dec. 16, walked about a quarter of a mile with me. Notwithstanding the limp in his gait arising from the state of the right leg, he is now able to walk a distance of two miles without fatigue."

Fig. 182.

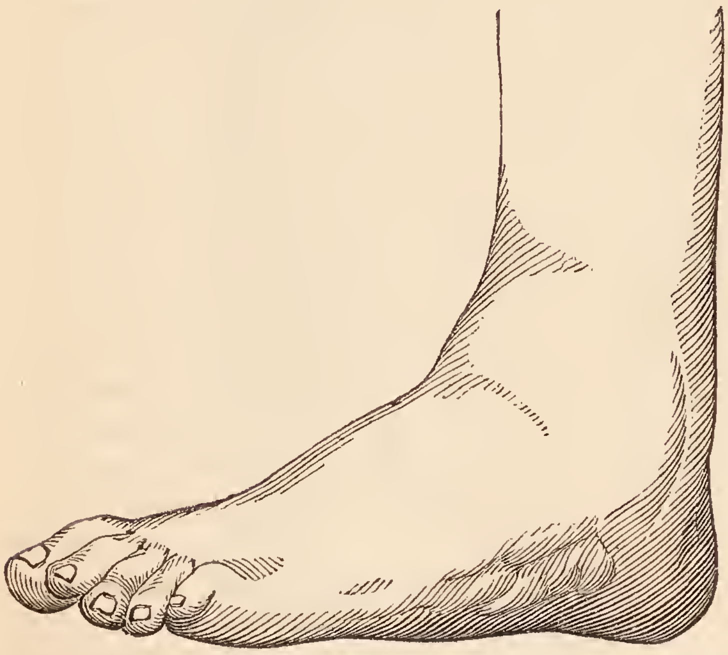

Fig. 182 *is a drawing of the foot taken in January,* 1839, *and showing its improved condition, within two months of the second operation.*

In a case of varus subsequently undertaken, I was induced, at the desire of the patient and his friends, to divide the tendon of the tibialis posticus and achillis tendon at one operation, in order to save time. The consequence was, that it afterwards became necessary to divide the tendo achillis a second time, before the full extension of the heel could be obtained. In another case, where the plantar aponeurosis was contracted in an extreme degree in both feet, I attempted to effect a cure in one of them, which was less distorted than the other, by the division of the aponeurosis alone. Considerable improvement followed this limited operation, but section of the tendon of the flexor longus pollicis was required before the inversion could be entirely overcome.

The reader will find a valuable mass of practical information, and an ample elucidation of the difficulties occasionally experienced in the treatment of talipes by operation, in the cases detailed by Dr. Little.

To the labours of Stromeyer, then, we are indebted for the establishment of this safe, speedy, and tolerably certain cure of deformities dependent on irregular muscular action. It is no detraction from the merits of the treatment, that many of the cases which have been cured by section of tendons might have been treated with equal ultimate success by plaster of Paris, or by certain of the machines recommended for the purpose. In the one case, from one to two months will suffice to rectify the distortion, and place the patient fairly on his feet; whereas, by the best conducted mechanical procedure, the treatment is prolonged to a period of many months, and often disappoints the expectations of the patient. Nevertheless, as the mechanical treatment forms a most essential part of the new practice, the same principles being merely applied under more favourable circumstances, the attention and ingenuity of the surgeon may be still advantageously directed to the improvement of those machines by which alone, in some few instances, the cure must still be attempted, and which, in by far the majority of cases, become important auxiliaries in the after-treatment.

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CLUB-HAND, as already stated, is a deformity precisely analogous to talipes. Its nature and causes are the same, the only difference being in the seat of the affection. The distortion ordinarily observed consists of a retraction and inversion of the thumb and fingers in a manner corresponding with the change of position the foot undergoes in varus. This is the effect of irregular contraction of the flexores digitorum, which may be the result of a preternatural action excited in them, or the consequence of paralysis of the antagonist muscles. As the nature and causes of club-foot and club-hand are similar, so also must be the principles of the treatment. Dr. Stromeyer has treated several cases by dividing the tendons of the flexores digitorum profundi et sublimes in each finger, opposite to the first phalanx. He does not, however, consider it advisable to divide *all* the flexor tendons. He found in one case that the fingers lost a part of their mobility in the second and third phalanges, which he accounted for by supposing that adhesion had taken place between the tendons of the flexor perforans and flexor perforatus, in consequence of section of both having been practised at the same point. In another case the inversion was traceable to the existence of several adventitious aponeurotic bands, extending from the fascia of the fore arm to the ulnar margin of the fore arm and palm. They were divided by a number of small incisions, partly subcutaneous, partly necessitating a division of the skin itself. "This interesting observation," adds Stromeyer[1], "in which very considerable deformity had formed itself after two slight contusions, is a pendant to the contraction of the fingers by contracture and hypertrophy of the aponeurosis palmaris described by Dupuytren. The case was perfectly cured."

Fig. 183.

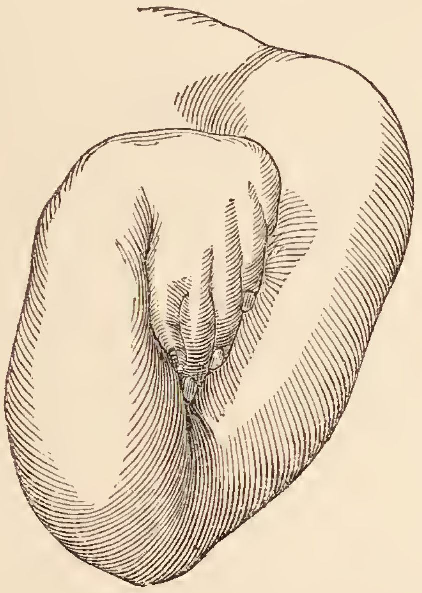

Fig. 183 *is a specimen of congenital club-hand, copied from Cruveilhier, Anat. Pathol, Livr.* 11.

The mechanical means required in the after-treatment of club-hand, where the tendons have been divided, are not so complex as those employed in the extension of a club-foot. By means of a hand-splint, compresses, and a bandage, all the extension necessary may be readily accomplished.

Henry T. Chapman.

COAPTATION (from *cum* and *aptare* to fit or adapt). The restoration to their proper place of the fragments of a fractured bone, or confronting the broken extremities. The expression is also extended to the reduction of a dislocation. In some cases, this procedure requires nothing more than the simple apposition of the parts, as in the bones of the head, the nose, and in the ribs; in others, it cannot be effected without extension and counter-extension. It should never be attempted but by the surgeon, and, even by him, should never be effected but with care and gentleness.

COLLYRIUM, a medicine for the eyes. Gr. κολλυριον from κολλυρα, which, according to Scaliger, signifies *bread sopped*, this having been early used as an application to the eyes.

The word Collyrium, as at present understood, means an eye-water, but formerly it was applied to any medicine for the eyes, whatever its form. Recurring to the original and wider acceptation, it is purposed in this article to treat not only of eye-waters, but also eye-salves, eye-powders, elastic fluid applications to the eyes, and douches.

The skin of the eyelids, and the conjunctival surface, are the parts of the eye which, under ordinary circumstances, are most open to the contact of remedies; the derivative lacrymal passages, though also directly, are less easily accessible. Of the other parts of the eye the proper substance of the cornea, when laid bare by ulceration, and the iris when it is prolapsed in consequence of a wound or penetrating ulcer of the cornea, are those which may become the subject of the direct action of medicinal substances. The lacrymal gland and meibomian follicles may be influenced by the action of collyria on their excretory orifices, in consequence of the sympathy depending on continuity of structure. The internal tunics also, by virtue of their contiguity may be sympathetically affected by applications to the conjunctiva; though in general, when these are stimulating, rather injuriously than beneficially. Hence it may be laid down as an axiom, that (to use the words of Dr. Mackenzie[1]) in the internal ophthalmiæ, and especially in the acute stage, the application of stimulants is useless or destructive, while in conjunctival inflammations, more is effected by their means than by almost any other kind of remedy.

Collyria have always been the resource of the mere oculist and half-educated practitioner; hence this abuse has induced many persons to decry applications to the eye nearly altogether. It is quite true that diseases of the eye are frequently dependent on the state of the constitution, or on an affection of some other organ, and that consequently he who in treating some kinds of ophthalmia should direct his attention exclusively to the eye affected, might exhaust his whole ophthalmic formulary in vain. But on the other hand, it is not to be denied that, in many cases, diseases of the eyes are purely local, or though originally produced by constitutional causes, have in the end become local, and must be treated by local remedies. It is therefore quite as one sided, and displays as much narrowness of views to disregard the local affection, and look to the constitution only, as to neglect this and apply remedies solely for that.

To the account of the different forms of applications to the eye, will be appended examples of formulæ, but in regard to these, it may be well to remind the young surgeon that it is not an acquaintance with this or that kind of application which is of so much consequence, as to be able to distinguish under what circumstances it should be employed. As regards the various medicinal substances of which eye-waters, &c. are composed, none have any specific virtue, and one will frequently act as well as another, if applied with method and discrimination, whilst without a correct diagnosis to guide in their application, they may be all equally injurious.

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[1] Letter before cited.

[1] Treatise, &c. 3rd edition, p. 364.

Cataplasms and Fomentations.—*Cataplasms* over the eyes are sometimes useful; but they must not be long persevered in, and the eyes ought to be carefully examined from time to time during their application. When applied warm, they should never be allowed to cool on the eyes. Most usually cataplasms are simply emollient, but they are sometimes narcotic, refrigerant, or astringent. The cataplasma aluminis of the Dublin Pharmacopœia is an astringent. It is composed of the whites of two eggs and one drachm of alum in powder, shaken together until a coagulum is formed. The coagulum is applied enclosed between two folds of fine soft linen or coarse lawn.

Fomentations.—As applications to the eye, fomentations are much more convenient and elegant than poultices.

Water simply may be used for the purpose, or, as a cold application, a solution of muriate of ammonia in rose water, mixed with a small quantity of spirit or vinegar; and as a warm fomentation, chamomile decoction, poppy decoction, and the like. The application is made by means of compresses of old soft linen or lint, or by means of crumb of bread sewed between two layers of soft muslin or lawn. These ought not be so heavy as to press unpleasantly on the eye, and they should be broad enough to cover both the eye and neighbouring parts.

After the removal of an application, the eyes must be carefully dried with a soft linen cloth.

During the intervals between the application of warm fomentations, the patient should not expose himself to the open air.

This is not the place to discuss the comparative merits of cold and warm applications to the eyes, but it is to be remarked, that the application of the former requires to be kept up for some time, whereas it is not necessary to continue the latter for more than half an hour occasionally in the course of the day, and during the night not at all.

Eye-waters are solutions of astringent, stimulant, or narcotic substances, or of all combined. Their state of concentration regulates the mode of application, hence the division into eye-waters properly so called, and drops for the eyes.

(*a.*) *Eye-waters properly so called*, are the weaker solutions, and are used to bathe the eye occasionally in the course of the day. The fluid is to be put into a cup in sufficient quantity and made tepid. The patient then holding his head over the vessel is to lave his eye with the water by means of a piece of sponge or soft linen rag; and after this has been done for a few minutes, some of the fluid may be dropped fairly into the eye by an assistant squeezing the soaked rag over it, while the patient lies on his back, and endeavours to hold his eye-lids apart. After this the eye may be laved again for a minute or so, and then carefully dried with a soft linen cloth. An eye-glass is not to be recommended.

A principal object in the process above described is to remove any discharge from the eye. In the blennorrhœal ophthalmiæ, when the eyelids are enormously swollen and cannot be opened, it may be necessary to inject the eye-water between the eyelids, after they have been cleansed as much as possible by means of the bathing simply. In using the syringe however, care must be taken not to injure the patient's eye by pressure or the like, and on the other hand, the operator should guard his own eyes from receiving any spark of matter.

In order to act on the inner surface of the lachrymal passages, the simplest way of applying the eye-water is to drop it into the inner corner of the eye, and leave it there some time till it is taken up by the puncta. It is sometimes also injected directly through the puncta and canalicules by means of Anel's syringe. Injections are occasionally thrown into the lachrymal passages from the opening of the nasal duct into the nose; but when an external opening into the lachrymal sac exists, whether it has been made by operation or the bursting of an abcess, we have the readiest access to the mucous surface of the lachrymal passages.

Examples.

℞—Aluminis gr. xxxij.
Aquæ ros. ℥viij.
Solve. Ft. aqua ophthalmica.

℞—Sulphat. zinci gr. xxxij.
Aquæ ros. ℥viij,
Acid. sulph. dilut. gtt. xxxij.
F. solutio pro aqua ophthalmica.

℞—Hydrarg. muriat. corros. gr. j—ij
Ammoniæ muriat. gr. viij.
Aq. ros. ℥viij.
Solve, &c.

℞—Lapidis divini[1] ℈j.
Aquæ destillat. ℥j.
Solve et cola.
Colaturæ adde Aquæ rosarum ℥vij.
Misce, &c.
Sig. Aqua ophthalmica.

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[1] ℞—*Æruginis*,
Nitratis potassæ,
Aluminis āā partes xvj.
Terantur simul et liquefiant in vase vitreo in balneo

N.B. To any of the above solutions a drachm or two of vinum opii may be added.

The following may be mentioned as directions for use:—

To half a wine-glass full add as much hot water, not exceeding an equal quantity, as to make the whole lukewarm. With the quantity thus prepared the eyes are to be bathed as directed.

(*b.*) *Drops.*—These may be applied by means of a quill or glass tube, but a large camel's hair pencil will be found the most convenient instrument. It is to be remembered, however, that to avoid accidents, each patient should have a separate pencil, which ought to be well washed every time it is used. The lower eyelid being slightly everted, its inner surface is to be touched with the loaded pencil, when the fluid will be immediately drawn off and diffused over the lower part of the conjunctiva. Pains must also be taken to allow the drop to make its way underneath the upper eyelid by drawing this from contact with the eyeball and then moving it slightly up and down. It is frequently necessary to evert the upper eyelid and pencil its conjunctival surface directly.

Applied in the ordinary way, salves, eye-waters, and drops scarcely ever come in contact with the conjunctiva of the upper eyelid and eyeball[1] in any degree of concentration, and too often what does get there acts rather as an irritant than otherwise. I consider it of great importance to insure the access of an application to the upper parts of the conjunctiva, because I have seen cases treated unsuccessfully, or rather irritated for a long time by applications, which, when properly introduced, did not fail of a speedy beneficial operation.

In order to apply drops to the eye of a child with the least possible trouble, the surgeon is to seat himself on a chair with a towel folded longways laid across his knees. On another chair on the surgeon's left hand and a little in front of him, the nurse with the child sits in such a way that when she lays the child across her lap, its head may be received on the towel, and between the knees of the surgeon, and thus held steadily. The nurse confining the arms and hands of the child, the surgeon easily draws down the lower eyelid and drops in the fluid; he then draws the upper eyelid up a little and also from contact with the eyeball in order to allow the drop to get underneath. The eyelids are then alternately to be drawn from each other, and made to approach so as to favour the spreading of the fluid over the whole conjunctival surface.

Examples.

Vinum opii, alone or more or less diluted, is often used for dropping into the eye.

℞—Nitratis argenti gr. iv—viij—xij.
Aquæ destillatæ ℥j.
Solve.

℞—Muriat. hydrarg. corros. gr. ſs —j.
Aquæ destillatæ ʒvij.
Solve et cola. Colaturæ adde vini opii ʒj.
Misce.

℞—Lapidis divini gr. v—x.
Aquæ distillatæ ʒvij.
Solve et cola. Colaturæ adde vini opii ʒj.
Misce.

℞—Extract. belladonnæ gr. x.
Aquæ destillatæ ʒij.
Solve et per linteum cola.

Eye-salves, *Unguenta ophthalmica.* Fr. *pommade ophthalmique;* Ger. *Augensalbe.* It is of great consequence that eye-salves should contain no gritty particles; the powders entering into their composition, therefore, should first be reduced by trituration to as impalpable a state as possible, and then carefully levigated with a little water or oil, previously to being mixed with the excipient. Substances soluble in a small quantity of fluid, such as the acetate of lead and sulphates of zinc and copper, may be dissolved. When camphor enters as an ingredient into an eye-salve it should first be dissolved in a fixed oil.

The excipient best adapted for eye-salves is prepared lard, simple cerate, or spermaceti ointment.

Salves are applied to the edges of the eyelids, or to the whole conjunctival surface. In the former case only should the patient or his attendants be intrusted with the application. In the latter case more discrimination as well as tact being required, the surgeon should always apply the salve himself.

Before applying a salve to the edges of the eyelids all incrustations of matter about the roots of the eyelashes must be removed. This is done by first rubbing the part with fresh butter or lard, and after a while bathing it with tepid water; the incrusting matter is thus softened, and may readily be separated with the finger-nail or head of a pin.

The anointing of the edges of the eyelids may be performed by means of a hair pencil, or simply with the point of the finger. The eyelid being held slightly everted, the salve is applied along its margin to the mouths of the meibomian follicles, then smeared outside the insertion of the eyelashes, and afterwards carefully rubbed in at their roots, the eyelids being at the time kept gently closed.

When a salve is to be applied to the whole surface of the conjunctiva, a piece the size of a split pea is to be taken up on the point of a hair pencil, or on the point of the nail of the little finger, and insinuated under the upper eyelid, while this is drawn forward from contact with the eyeball. When the salve is fairly in the eye the upper eyelid is to be

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arenæ. Liquefactis adde camphoræ tritæ partem j: Misce.

Massa refrigerata servetur sub nomine Lapidis Divini.

[1] In illustration of this it may be mentioned, that in most or all the cases in which, from the abuse of the nitrate of silver drops, the conjunctiva has become discoloured, it is the lower part of this membrane which is so affected.

gently drawn down and rubbed over the eyeball with the finger for a minute or two, in order to diffuse the salve, now melted by the heat of the eye, between the eyelids and eyeball and consequently all over the conjunctiva.

If the palpebral conjunctiva be the part on which the salve is principally to exert its action, the application may be limited to it, in which case the pain is less severe than in the former. Having everted the eyelids, the exposed conjunctival surface is to be rubbed with the salve either by means of a hair-pencil or the point of the finger.

Salves are sometimes applied to the lacrymal passages by smearing the meshes, catgut-strings, &c. which are introduced into the nasal duct, whether from the nose or through an external opening into the lacrymal sac.

In regard to the application of a strong salve to the eye it is necessary here to give a caution, viz. not to insert it in a lump within the lower eyelid and leave it there. I have seen the conjunctiva of the inferior palpebral sinus in a sloughy state from a lump of nitrate of silver ointment having been put in, and no care taken to diffuse it by rubbing on the eyelid. In the case of ointment inserted under the upper eyelid, the natural motions of the part will make up in some degree for the neglect of the surgeon.

Examples.

℞—Oxid. hydrarg. rubri bene lævigat. gr. iii. vj.—xv.
Axungiæ præparat. ʒij.
Misce accuratissime: ft. unguentum ophthalmicum.

The two weaker forms are used for anointing the edges of the eyelids, and may be entrusted to the patient. The stronger form should be applied only by the surgeon himself. Applied to the whole conjunctival surface I have found it a very efficient remedy in various inflammations of the conjunctiva, and ulcers, specks, &c. of the cornea. It is less severe in its operation than the nitrate of silver ointment.

The citrine ointment of the pharmacopœias, diluted with three or more parts of lard and oil, is a useful application to the edges of the eyelids.

℞—Argent. nitrat. gr. ij—x
Unguent. cetacei ʒj.

Prius lævigetur bene nitras; dein misceatur accuratissime cum unguento.

This, with the addition of liq. plumb. subacet., is the black ointment of Mr. Guthrie, which has been used with so much success not only in chronic, but also in cutting short acute inflammations of the conjunctiva, on the principle "of exciting an action greater and of a different nature to that already existing in the part."

The following is what is known by the name of Janin's ointment for the eyes.

℞—Præcipitat. alb. gr. xv.
Tutiæ præparat.
Boli armen. ppt. āā ʒſs.
Adip. suilli ʒi—ʒij.
M. exactissime: ft. ungt. ophthalmicum.

It is occasionally required to touch fungosities of the conjunctiva, ulcers of the cornea, prolapsus of the iris, partial staphyloma, with very active substances, such as nitrate of silver in substance, butter of antimony, or caustic potass. In this case the eyelids must be held fully apart, and, after the application, which ought to be carefully confined to the particular spot, some mild fluid is to be dropped in; sweet oil, by not dissolving the substances employed, prevents their spreading over the neighbouring parts, and is, therefore, the best adapted for the purpose.

Eye-powders or Dry Collyria.—*Pulveres ophthalmici vel collyria sicca;* Fr. *Poudres pour insufflation;* Ger. *Augenpulver.*—The application of stimulating powders to the eye is much less frequent now than formerly. They have been principally used against specks of the cornea. The late Baron Dupuytren and Dr. Fricke of Hamburg, have strongly recommended insufflations of calomel, in the puromucous ophthalmiæ.

The powder, reduced to the greatest impalpability, *pulvis subtilissimus,* is blown into the eye through a quill, or applied by means of a moist hair pencil. The surgeon should always do the operation himself.

Refined sugar or sugar-candy reduced to a very subtle powder has been principally used either alone or as an excipient for, and diluent of, other substances.

Examples.

℞—Sacch. purif.
Oxid. zinci āā pp. æq.
Misce, et tere ut fiat pulvis subtilissimus.

℞—Oxyd. hydrarg. rubri gr. x.
Sacch. purif. ℥j.
Misce, et tere, &c.

℞—Calomelanos
Sacch. purif. āā pp. æq.
Misce, et tere, &c.

To this one-third of a part of powdered opium may be added.

℞—Aluminis usti
Sulphat. zinci
Boracis āā ℈j.
Sacch. Alb. ℈ij.
Misce, et tere ut fiat pulv. subtiliss.

The proportions above given may be varied according to circumstances.

Medicated bags, *sacculi medicati;* Fr. *sachets.* Ger. *Kräuterkisschen.*—Bags of aromatic herbs, so much used in Germany, act principally by the exhalations they give out. They also serve to keep up dry warmth[1].

The bags are made of coarse lawn or muslin, washed and rubbed soft. Being lightly filled, the bag is sewed close, and then quilted at different places, so as to keep the materials equally spread, and prevent them from sinking down. For the eyes, the bags must be made as light as possible; not more than of the thickness of a finger, and about the size of a playing card. They are fixed to a band passed round the forehead so as to hang over the eye ; they ought not to be bound over the part. In general the bags are warmed before being applied.

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[1] M. Mayor, of Lausanne, has lately recommended the application of carded cotton *over the eyes,* in certain ophthalmiæ.

The materials used for filling the bags are aromatic species (chamomile-flowers, sage, rosemary, thyme, &c.) mixed or not with shavings of camphor. The species are reduced to a coarse powder, from which all dust is to be separated by a sieve. To fill a bag of the size above indicated one and a half to three drachms of herbs, flowers, &c. will be required.

Bran or bean-flour is much used as an excipient and diluent of the aromatic or narcotic materials.

When *camphor* is the only active substance employed, it may be applied by means of a compress, prepared by enclosing a layer of cotton wool, impregnated with it, between two layers of gauze. The impregnation is readily effected by soaking the wool in strong spirit of camphor, and then allowing it to dry quickly : when dry the wool is teased out.

Examples.

℞—Flor. chamomill.
—— sambuc. āā p. j.
Farin. fabar. pp. ij.
M. F. Pulvis.

D. S. Ad sacculum e linteo factum, quo oculus affectus obtegi debet, implendum.

A bag filled with the following narcotic powder is recommended, by Dr. von Ammon[1] in iritis :—

℞—Pulv. Hb. belladonnæ ʒj.
Farinæ amygd. dulc. ℥j.
F. Pulvis.

The *vapour of the weaker volatile fluids* is applied by spreading the fluid out on a warm surface and allowing it to evaporate near the eyes. Thus, having poured a few drops of the fluid into one hand and spread it out on the palms of both, by rubbing them quickly together, the hollow of the hand is to be held more or less close before the eye, according to the strength of the material and degree of action desired.

Watery Vapours gently soothe the eyes ; the patient holds his face over a vessel containing hot water, with or without any aromatic or narcotic admixture, so that the steam is received by the eyes. A cloth is thrown over all. When it is wished to have the steam play more directly on the eye, a funnel is inverted over the vessel, and the tube directed towards the eye at a proper distance, care being at the same time taken that the steam is not too hot.

After the application, the face and eyelids are to be well dried, and exposure to any draught of air carefully avoided.

Examples.

Steaming mixtures may be prepared, by putting into a cupful of hot water a teaspoonful or two of one or more of the following preparations :—

Tincture of opium.
Tincture of camphor.
Compd. tincture of camphor.
Tincture of hyoscyamus.
A spirituous or vinous solution of extract belladonna.

A douche, usually of cold spring water, is sometimes applied to the closed eyelids, or to the neighbourhood of the eye. There are particular douche-apparatuses, but a carefully and gently directed stream from a syringe, or from a funnel with its throat slightly stuffed with tow, suspended over the patient's face will serve the purpose at an exigency.

In the weak and rheumy eyes of old persons, and in a similar state remaining after an attack of ophthalmia, it is often agreeable, and indeed productive of great relief, occasionally to draw some cold body across the eyelids. For this purpose a long slender bottle with a smooth round bottom, and filled with ice has been recommended.

(*T. Wharton Jones.*)

COLOBOMA, *κολοβωμα*, *mutilatio.*—This term, in ophthalmology, was first applied to a fissure of the eyelid, like hare-lip, the result of a wound in which by neglect the edges had been allowed to cicatrize separately. A fissure of the eyelids has been, though rarely, met with as a congenital defect. The term coloboma has been since extended to a fissure of the iris, whether congenital or produced by injury, extending from the pupil towards the ciliary margin. There are thus two genera, viz. *coloboma palpebræ* and *coloboma iridis,* (*iridoschisma,*) and two species of each, viz. the *congenital* and *traumatic.*

Coloboma palpebræ.—This is to be treated by making the edges of the fissure raw, and uniting them by the hare-lip suture, in the same manner as when a Λ-shaped piece has been cut out for the cure of certain forms of ectropium. What are called insect-pins are well-adapted for the suture. They should be inserted, and brought out at some distance, about one-tenth of an inch, from the edges of the fissure, and not implicate the conjunctiva. It is to be remembered also, that the first pin is to be inserted near the ciliary margin of the eyelid, in order to insure evenness at this place. Should it be found that, when the coloboma is united, the edge of the eyelid is so short, that it presses upon the eyeball, and has a tendency to turn inward, an incision should be made near the outer canthus, through the whole thickness of the eyelid, and perpendicular to its edge, in order to relieve the stricture. This recent coloboma is to be prevented from uniting by the first intention by keeping its edges retracted. Such a proceeding I have adopted with great advantage in old cases of inversion of the lower eyelid, depending principally on transverse shortening of its free edge.

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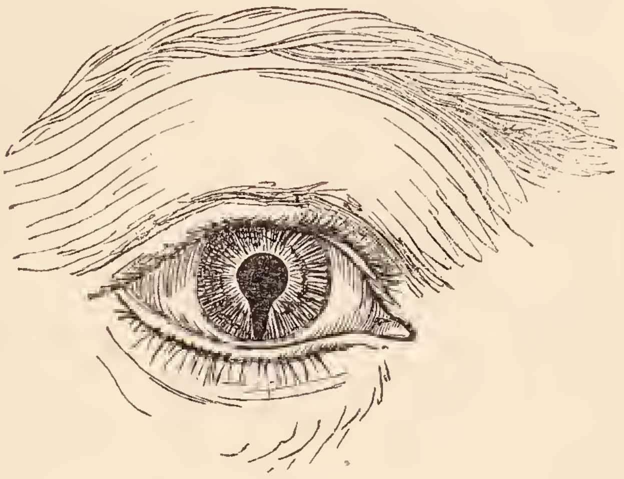
[1] De Iritide, p. 28. Lipsiæ, 1838.

Coloboma iridis congenitum.—The following case and figure, borrowed from Dr. Mackenzie, will afford a good idea of this affection :—

Fig. 184.



"On the 31st of January, 1831, I was requested by Mr. Roy to examine the eyes of Boyd Armour, a recruit, in the Barrack Hospital, Glasgow. In both eyes of this individual, the pupil was prolonged, as is represented in the annexed sketch, towards the lower edge of the cornea. This was the congenital form of the pupils; and though it certainly gave to the countenance a very peculiar and somewhat wild expression, it had not been noticed at the time of enlistment. The vision, as far as could be ascertained, was perfect. Both the natural pupil, and the cleft proceeding from it, contracted, on sudden exposure to light; but the cleft slowly, and not so as to close, at least in a moderate light[1]."

In the instance just described, the fissure was observed to become narrower in approaching the ciliary edge of the iris, but in other instances a converse disposition has presented itself. In some cases the fissure has been found to implicate merely the pupillary edge of the iris like an angular notch. Professor Rau of Berne, amongst several cases of coloboma iridis, has met with three examples of a peculiar variety, in which the proper substance of the iris only was involved in the fissure, whilst the uvea remained perfect.

Sometimes one eye alone has been affected with coloboma iridis, sometimes both. Stilling[2] saw a case in which there was this malformation in one eye, and in the other a double pupil like a figure of 8. In some families coloboma iridis has been observed to be hereditary.

In none of the cases observed by Walther could anything like the ciliary processes be discerned at the lower extremity of the cleft. In general, Walther found the lower half of the eye less convex than the upper, and apparently less developed: he also noticed that the whole eye was in some cases smaller than natural, the cornea flatter, the pigment deficient, and the eyeball oscillatory. In some cases a complication with opacity of the lens has been found to exist, but a considerable degree of vision still remained, as the light penetrated to the retina through the fissure of the iris, and thence through the zonula lucida by the circumference of the lens. In numerous cases, however, the eyeball has appeared quite natural in other respects, and vision good.

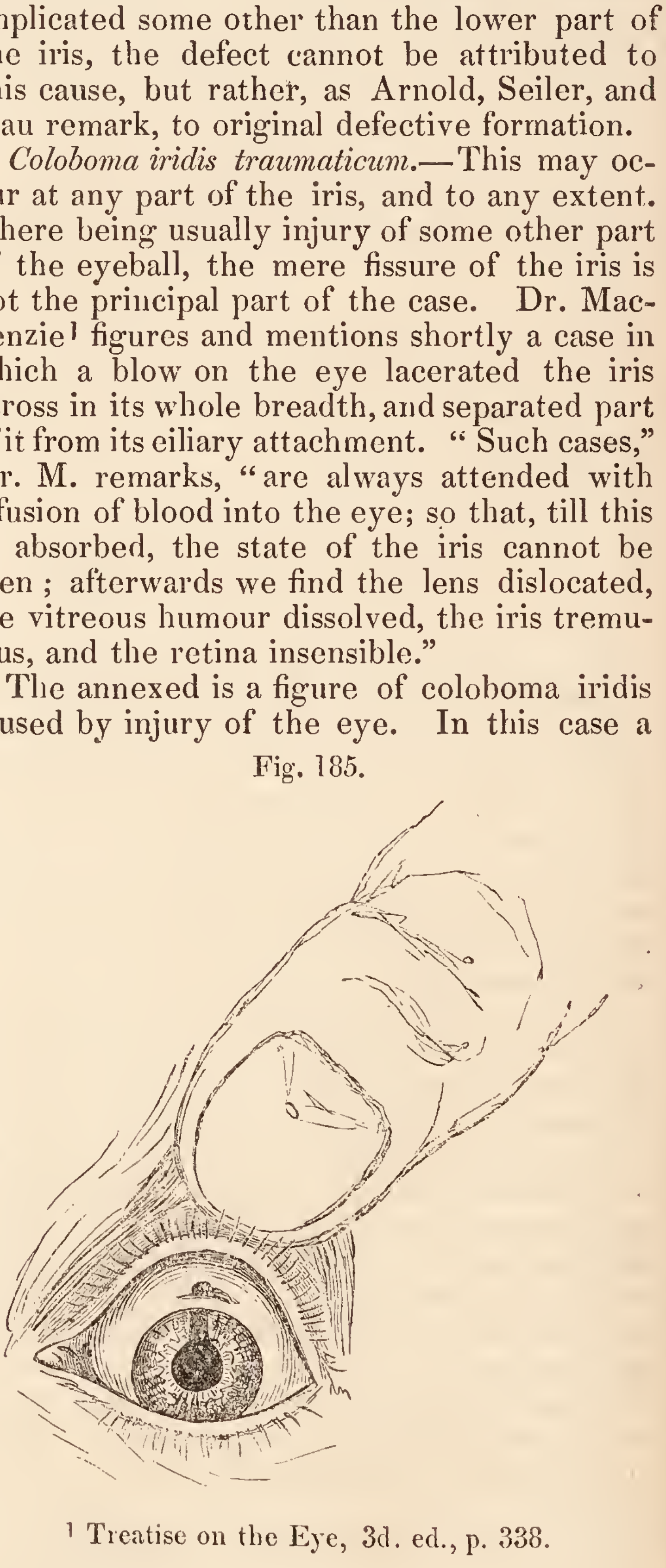
In congenital coloboma iridis the cleft has usually existed at the lower part of the iris; cases, however, have been described in which it involved other parts.

In one case, Dr. Ammon found on dissection that the coloboma iridis was a part merely of a more extensive fissure, involving both the retina and choroid. Observations on the development of the eye show that at a very early period a fissure extends through the retina, choroid, and iris, at the lower part. Coupling this with Dr. Ammon's observation, we are readily led to agree with Walther, Müller, and others, that coloboma, when it implicates the lower part of the iris, is owing to an arrestment of development. In those cases, however, in which, as is said, the fissure implicated some other than the lower part of the iris, the defect cannot be attributed to this cause, but rather, as Arnold, Seiler, and Rau remark, to original defective formation.

Coloboma iridis traumaticum.—This may occur at any part of the iris, and to any extent. There being usually injury of some other part of the eyeball, the mere fissure of the iris is not the principal part of the case. Dr. Mackenzie[1] figures and mentions shortly a case in which a blow on the eye lacerated the iris across in its whole breadth, and separated part of it from its ciliary attachment. "Such cases," Dr. M. remarks, "are always attended with effusion of blood into the eye; so that, till this is absorbed, the state of the iris cannot be seen; afterwards we find the lens dislocated, the vitreous humour dissolved, the iris tremulous, and the retina insensible."

The annexed is a figure of coloboma iridis caused by injury of the eye. In this case a

Fig. 185.



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[1] Lond. Med. Gaz. vol. ix. p. 738. London, 1832.

[2] Holscher's hannoverischen Annalen, vol. i. p. 107.

[1] Treatise on the Eye, 3d. ed., p. 338.

grain of small shot entered the left eyeball immediately above the upper edge of the cornea. Nine days after the accident, Dr. Mackenzie[1] saw the patient, and found the eye in the state represented by the figure. There was a red vesicle-like protrusion of the choroid at the place where the grain had entered the eye, and round this the sclerotica was considerably depressed. The iris was deficient at its upper part, which had been torn through by the grain of shot. The eye finally became atrophic.

BIBLIOGRAPHY.—The congenital malformation of the iris treated of in this article appears to have been first described and delineated by Thomas Bartholin, in "Acta medica et philosophica Hafniensia," ann. 1671 et 1672. Hafn. 1673, 4. p. 62. Albinus described a case in his "Annotat. acad." lib. vi. Leidæ, 1764, p. 49. It was next noticed by Bloch, in his "Medicinische Bemerkungen," &c. Berlin, 1774. Professor Walther, who first proposed for it the name of *Coloboma Iridis*, recorded a case in his "Abhandlungen aus dem Gebiete der practischen Medicin," p. 72. Landshut, 1810; and afterwards discussed the subject more fully in a memoir entitled "Ueber einen bisher nicht beschriebenen angebornen Bildungsfehler der Regenbogenhaut, nebst einigen Bemerkungen über angeborne Missbildungen überhaupt," in the "Journal für die Chirurgie und Augenheilkunde," edited by himself and Professor Graefe, vol. ii. p. 601. Berlin, 1821. Since then the subject has occupied the attention of several others in Germany. See different memoirs in "Ammon's Zeitschrift für die Opthalmologie," and also in his "Monatsschrift für Medicin, Augenheilkunde und Chirurgie," vol. iii. p. 59. Leipzig, 1840. In this country the subject has been handled by Dr. Mackenzie in an interesting memoir contained in the "Medical Gazette," vol. ix. p. 738. London, 1832. It will be seen that this memoir has been laid under contribution in the composition of the present article.

(*T. Wharton Jones.*)

COMMINUTION. The crushing or fracture of bone, by which it is broken into numerous splinters or fragments.

COMMOTION. See CONCUSSION.

COMPRESS, (from *comprimo*, to press upon; *splenium plagula*, Lat.; *Bäuschleim*, Ger.) a pad formed of folds of linen, lint, rag, caoutchouc, or other material. Compresses vary in shape and substance according to the object for which they are employed, and perform an important part in many surgical ministrations. Their office appertains in some respects to that of bandages; as, for instance, in filling up void spaces, by which means the pressure of bandages is rendered more firm and even—retaining in their proper places such remedies as may be applied—protecting injured parts from the contact of the air, from external shocks, or even from the pressure of splints or other materials that may have been employed in the dressings. Particular names are given to them, derived from their shape, situation, use, &c.; hence the *long*, *square*, *circular*, *triangular*, and *graduated* compresses; these last are formed by placing pieces of lint, of gradually increasing sizes, one upon another, the smallest being in contact with the part upon which pressure is to be made.

COMPRESSION, from *comprimo*, Lat. *Zusammendruckung*, Ger. A remedial agent, of great value in surgery, and by which pressure is made by mechanical means on the organic tissues. The indications to its employment are exceedingly various, and its effects vary according to the degree, mode, and duration with which it is applied. It exercises considerable power to alter the condition of any tissue to which it may be applied, whether to produce disease or to cure it, whether to increase the growth of parts or to cause their diminution; and, as entering into the detail of almost every ordinary duty of the practical surgeon, it merits more attention than has been given to it hitherto.

Compression, like any other mechanical power, presents to us the complete theory of the lever: viz. a power acting by pressure, a fulcrum, and a point of resistance, which is the tissue itself upon which the pressure is thus brought to bear. It may be applied in such a manner as to act from the surface towards the centre: and this mode of it is termed *concentric* pressure, or compression properly so called; or from the centre towards the surface, or *excentric* pressure, to which the name which expresses its effect is applied, namely, dilatation. But whatever be the mode of its application, its effects are due to its power of condensing the tissues, and of retarding or impeding altogether the influx of the circulating fluids; these effects being according to circumstances, support, deposit, absorption, or gangrene.

When exerted in a slight degree only, it simply gives support, and in this way affords excellent assistance to weakened parts. When more forcibly applied, and for a short period, it induces an increase of growth of natural or diseased parts; and, when carried to a greater degree still, it is capable of producing the absorption of morbid deposits, or even healthy structures; and, in its last degree of severity, is occasionally used, with a view to produce the death of parts or their mortification.

We shall consider the subject in the order of these effects, showing the process by which each effect is produced, and under what circumstances each amount of pressure may be surgically useful.

The effect of compression in its lightest form, is to give *support* to *weakened* parts,—a fact with which we cannot fail to be impressed when we observe the natural bandages which are placed around the important organs of the body for their preservation in a state of health. The investing membranes of the brain, heart, liver, kidneys, testicle, serve not only as shields from external injury, but also from the friction of their surfaces in the various movements of the body; they also contribute much to the tone of the blood-vessels entering into the intimate texture of those organs; and thus regulate the growth of those organs, by preventing the ingress of more blood into them for their nutrition than is suited to their respective sizes and offices. It would be readily seen how inordinate and irregular might be the growth of these organs, were it not for the mechanical resistance set up by the firm, steady, and yet unyielding compression exercised around them by the inelastic serous membranes which invest them. This will be made familiar to us by perceiving the painful resistance offered to excited vessels of an organ under inflammation. The most familiar example of this, because frequently under our observation, is an inflamed testicle. While the organ, inflamed for the first time, expands, the tunica albuginea resists, so that, as soon as the activity of the excited blood-vessels is checked, the correcting efforts of this membrane are exerted to restore the organ to its natural size. A testicle is seldom permanently enlarged by a first attack of severe inflammation; but it often becomes so under the gradual effects of its excited vessels, which gradually distend the investing membrane. It is enough, however, to know that such a wholesome check is offered by the mechanical support of these natural bandages. The fasciæ investing the large muscles of the body exercise a similar power, not only to control the inordinate action of the muscles, but to prevent their irregular and inordinate enlargement.

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[1] Op. cit. p. 349.

From such observations we are led to employ the same means to afford an artificial aid to parts which have lost their natural support. In this way bandages in their different forms are employed by the surgeon to support parts in their natural situation; in descent of the abdominal contents, for example, trusses in hernia and prolapsus recti, pessaries in prolapsus uteri, &c.

Compression, indeed, is continually employed in surgery, to effect the union or retention of parts in their natural situations, to arrest hæmorrhage, to prevent or disperse œdema, to bring the sides of cavities from which fluids or solids have been removed into contact or proximity, to oppose the development of tumours, to produce the destruction or absorption of serous cysts, to keep in contact the broken extremities of bones in fractures, and to control the actions of the muscles by which they might again be displaced, to suspend the circulation temporarily in large vessels, and to dull the nervous sensibility of parts in order to render operations less painful. As these applications of compression, however, will be considered elsewhere, my object for the present will be simply to show what are its effects, in such a degree only as it affords support, on the tissues of the body under local disease, and under what circumstances it may be usefully employed.

In chronic inflammation:—The condition of a part long under inflammation is simply that of an over-distended, therefore weakened, state of its blood-vessels. The effects of which are continued deposit from these vessels, and subsequently purulent formations, and ulceration, or absorption. To this weakened condition of vessels, and with a view to promote the uninterrupted course of the circulation, compression, in the form of support, is especially applicable.

The most simple state of distended vessels, though not actually an inflamed condition, is the *varicose vein.* Here the coats of the veins are yielding to the column of blood within them; the blood is thereby delayed in circulation towards the heart, and consequences follow which attend a distended state of vessels begun in inflammation, deposit, and ulceration. If the veins of the leg are enlarged, the leg swells and ulcers form. It is in such a case that compression, sufficient only to give *support* to the weakened veins, thereby to diminish the quantity of blood in them and aid its return to the heart, is peculiarly useful.

The varicose ulcer, as it is termed, in this its simple state, attended with swelling from effusion in the cellular membrane of the limb, is for the most part cured by judicious bandaging. The ulcer needs only protection,—the limb and its veins support. The bandage mostly employed, and the most beneficial, is the adhesive strap. In its use, however, the greatest care is required that no more is done by it than is necessary to support the parts; if it be used too tightly it will cause inflammation; if irregularly it will produce ulceration of itself; and if partially applied it will irritate rather than soothe the sore. In no other hands has this form of bandage been more efficiently employed than by the late Mr. Baynton, of Bristol, whose plan and principles deserve the attention of surgeons.

In chronic inflammation, compression in this way is most successfully employed: according to the extent to which the inflammation has been carried, it may be advisable, or otherwise, to call in other means to its aid. It is quite manifest that the cures related which have occurred under the bandaging of Mr. Scot, are more attributable to the accuracy with which the compression is exerted, than to the specific operation of the mercurial which is combined in his plan. We know, at least, that the latter will accomplish very little without the former.

Pressure will also have the effect of increasing the growth of parts to which it is applied. In this way, it seems to act as an irritant; the principle governing its use as a support to the blood-vessels being, as it were, exaggerated. The compression, under these circumstances, may be too great, too partial, or too inconstant. In such cases deposit is the result. The most familiar example of this, is the growth of the cutis to produce what is called a corn,—the thickening of the hernial sac. In these cases the pressure for a time is great, but it is occasionally withdrawn. A knowledge of this effect can only be made practically useful by avoiding it. Thus, in the imperfect attempts to bandage a part for the cure of an ulcer, where support only is the object in view, an increased deposit may be occasioned around the sore, and the cure thereby delayed.

Another effect of compression is the absorption of parts. A degree of compression, greater and of longer duration than such as is productive of the preceding effects, is capable of inducing the actual destruction of parts, by causing them to become absorbed. Examples of this are daily before us; a gradually increasing quantity of pus deposited in the cellular membrane, readily finds its way to the surface, by the continued compression exercised on the surrounding parts: the walls of adhesive lymph in which the deposit of pus first takes place gradually become absorbed as the compression of the distended sac increases. The structures in immediate contact with an increasing aneurismal sac are speedily removed—even bone itself undergoes a similar waste and absorption from the pressure of an aneurism. Bone forcibly pressing against bone becomes absorbed; an example of which may be seen in the advanced stages of diseased hip, in which the head of the femur is drawn by muscular action against the acetabulum or its edge; in the one case the head of that bone becomes absorbed, in another the very depth of the socket itself; in another its upper and outer edge, and the bone is even dislocated. The knowledge of this power should lead us to imitate this process, so as to remove diseased parts which will not be dispersed by other means. As I know not the limit of this power when properly applied and perseveringly followed up, neither am I prepared to deny its effect in producing the absorption of scirrhous deposit. Mr. Young[1] asserts its power as a remedy in such cases; and the facts adduced by him are staggering. The remedy was tried; but in other hands it failed. I have my doubts as to the full employment of compression by others in the effective way in which Mr. Young employed it. It seems to me as yet deserving the attention of the profession. The cases in which I have known it tried, and used it myself, were those in which cure by operation was impossible, from their advanced condition. I know not that any portion of the truly scirrhous mass was absorbed, but the tumours were much reduced in size, and several were broken down into two or more portions. It may have been that the matter absorbed in these cases was only the extraneous deposit, which had not as yet attained to the scirrhous degeneration, whilst the true scirrhous substance remained entire. Still even in these cases great good was obtained by diminution of bulk, and so long as the pressure was employed, by an entire alleviation of pain.

In order to understand so as usefully to apply compression in that degree in which it produces absorption, we have only to recollect that throughout the body, in its healthy condition, there are organs adapted to every part which support a continuous action of supply and waste.—In some this operation is conducted by special organs for each purpose—but in the extreme parts these processes are in constant operation, simply, by means of the arteries and absorbents. The arteries are the instruments of deposit and growth, the absorbents are the organs of waste; and so long as these actions are equally balanced, so long only is the healthy condition of a part maintained. When either of these are in excess, disease is the result. The result of chronic inflammation, is increased deposit by the arteries; exhibiting itself in a variety of ways: and that growth or deposit often receiving its character, as in scirrhus or cancer, from a peculiar condition of the constitution, perhaps from a peculiar condition of the blood itself. When the balance of action between the vessels of growth or supply, and those of waste, is lost, any power which can restore it, must be considered an efficient means to restore to health the part which has suffered from the loss of it. If compression be exerted with just sufficient force to lessen the quantity of blood sent to the diseased part, thus preventing deposit, the balance will be given in favour of the absorbents. An illustration of the effects of this degree of pressure may be experimentally tried on an ulcer with callous edges, this being in fact the condition of such an ulcer. The sore itself is deep in proportion to the height and thickness of the callous edge; the granulations small, pale, and bloodless; the edge horny; the surrounding parts, the skin, more or less inflamed; the veins more or less varicose. An ulcer, so circumstanced, is kept up, if not produced, by the barrier, which is set up by the callous ring which surrounds it; the blood-vessels have no ingress there to furnish the sore with flesh; the absorbents are at their work of excavation, and the sore is daily deepened; the granulations are pale and languid; their secretion watery. If such a sore be treated by compression on the callous ring, this will be absorbed and blood be let in, to fill up the chasm; granulation becomes effective, rises to the surface, and cicatrization speedily follows. It was to such cases Baynton applied his adhesive strapping bandage. He bandaged from the foot upwards to support the weakened blood-vessels—the varicose veins. But to the *sore* he applied a *greater* degree of pressure, and success attended his application. The failure of Baynton's strap arises often either from the principles of its use not being fully understood or fairly carried out. I have found that a piece of sheet-lead bound tightly down over the sore and beyond the callous edges, answers admirably; the compression is equal, which with strapping over the face of the sore it may not be. I usually bandage with strapping closely up to the sore from the foot, then place a piece of smoothly rubbed sheet-lead *on* the sore, about half an inch or an inch beyond the callous ring, and bind it down by the same straps. From day to day the edges become absorbed, and granulations spring up, and the cure is quickly effected. The lead should be daily renewed; nothing need be placed on the sore underneath the lead. The success of this plan is very general. The mode of application of compression must not, however, be taken to be a matter of indifference; for upon this, in most cases, depends its efficacy. When applied improperly, particularly in the course of nerves, it often excites intolerable pain; or, in the course of the absorbent trunks, engorgement of the lymphatics.

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[1] Minutes of Cancer.

Compression, if exerted on a part in sufficient degree of intensity to arrest the circulation of blood through it, will produce mortification. This may be caused by the pressure applied on a single blood-vessel of sufficient size and importance to the life of the part, or by compressing all the vessels which nourish and feed the part. One of the evils consequent on the tying an artery for the obliteration and cure of aneurism, is mortification of the limb. I have witnessed the compression produced by a small spicula of bone on the artery in the ham, the result of comminuted fracture, produce gangrene of the leg. I have seen a case of effusion of blood in the popliteal space, from the wounded artery, produce mortification of the limb. But when the circulation is entirely impeded by compression exerted on all the vessels of the part, mortification is the necessary result. I have witnessed gangrene of the hand, from tight bandaging for fracture of the bones of the fore-arm. The sloughing penis in paraphimosis is an example of this kind of compression. A strangulated intestine is another. Surgery, however, imitates these examples. It resorts to a ligature around a pendulous tumour, which drops off under the strangulation of its vessels. The same expedient is resorted to for the destruction of hæmorrhoids, and most successfully in the obliteration of nævus. The strangulation of a portion of the tongue has been successfully adopted in cases of cancer.

The employment of compression in the cure of aneurism has been spoken of under that head. Its effects as a hæmostatic will be treated of under the head of HÆMORRHAGE and TOURNIQUET. For the uses and applications of excentric pressure see DILATATION.

(*Wm. Wickham.*)

COMPRESSOR. An instrument for the compression of arteries invented by J. L. Petit. Several modifications of it have been since produced by Dupuytren, Colombat, and Charriere, but all on the same principle. The limb, or parts, being compressed between two pads attached to a circular hoop, and the pressure being effected by means of a screw which acts on one of the pads. Modern makers of these instruments have aimed at establishing compression upon arteries without interrupting the course of the blood in the collateral arteries. (See TOURNIQUET, and ANEURISM.)

CONCUSSION, from *con* and *cutio*, to shake together. *Erschütterung*, Ger.; *commotion*, Fr. The shock or commotion produced on living organs by the sudden impetus of force or momentum, whether the force be applied directly upon, or at a distance from, those organs.

The effects of concussion are propagated with an intensity proportioned to the compactness or density of the elements through which the force is transmitted. The soft parts, when struck, are contused, ruptured, or destroyed; they suffer the violence themselves, and transmit its effects but feebly, if at all, to the denser structures. The bones, on the contrary, the hard ones more especially, transmit shocks with unabated force to the organs in their vicinity,—shocks which produce, in proportion to the delicacy of the structure of the organ so injured, and the importance of its function, the most serious, and indeed, sometimes, immediately fatal consequences. When the transmission of the shock is most complete, dissection will not enable us to detect any apparent alteration in the tissue of the injured organ. Thus external violence applied to the head, or even to the trunk, may affect the brain or spinal marrow to such a degree, as to give rise to the most alarming symptoms, followed by death; and yet not the slightest trace of its destructive commotion can be discovered. When the shock has produced laceration of the organ, the case is not one of commotion or concussion, but of counter-coup. The concentration of the shock, whereby the laceration has been effected, protects the general mass from the effects of the commotion. The same thing may be observed when the bones, instead of transmitting the shock, are fractured; in this case also the force is so spent, that it is not propagated, at least to a dangerous extent, to the neighbouring organs.

Whatever be the change induced in the organic structures by the shock thus transmitted, whether it be from the destruction of the cohesion in the living molecules, or from simple stasis of the vital actions, the effect varies. In some cases of violent concussion both function and life are at once destroyed; in others the function only is suspended, and the individual is stunned, or insensible. After remaining in this state for an indefinite period, the functions are gradually restored. The temporary inactivity of the injured organs is not, however, followed by a healthy and vigorous activity. The circulation through them is languid. The blood flows to the organs; but the latter do not transmit it with their wonted celerity, and they become congested. The surgeon must be on the watch for these phenomena, and act with caution and decision. The symptoms indicative of collapse demand the employment of stimulants, internal as well as external. The congestion and consecutive inflammation must be combated by antiphlogistics. See HEAD, INJURIES OF.

CONDYLOMA, κονδυλος, a knot, Gr., *condylome*, *excroissance*, Fr. The term *condyloma* is employed in so vague, I might almost say in so contrary a sense, by different persons, and in different countries, that a definition of it is equally difficult and necessary. That difficulty is aggravated by the circumstance, that two kinds of affections are comprised, if not confounded, under the name, and have not, so far as I can ascertain, been clearly and satisfactorily distinguished by even the recent writers upon syphilis.

On a former occasion, and in another work[1], I took the liberty of offering some observations on the subject, and endeavoured, I fear with indifferent success, to present a succinct account of the affection. The present article is substantially a reprint of that paper, with such alterations and additions as further experience, and the publications of other gentlemen, have given birth to.

For convenience of description, as well as for practical utility, *condyloma* appears to admit of division into three principal forms. And though they have a tendency to run into each other, and their distinction is not always either profitable or possible, yet, on the whole, it is founded in convenience, and must be recognised by those who would aim at an accurate acquaintance with the disease.

The *first variety* of condyloma might be termed the *simple condylomatous excrescence*, as it occurs independently of venereal taint, and is merely the result of irritating secretions. It consists of irregular thickening of the cutis, or of the mucous membrane at the outlets of the genito-urinary or intestinal canals, which may or may not be thrown into a fold, including thickened and consolidated subcutaneous cellular tissue.

The *second* and the *third varieties* are probably rather grades of one than possessed of specific differences. And yet they do differ.

The *second* variety is a superficial, nearly circular, deposit in the cutis, of a vascular character, and accompanied, or preceded, in most instances, if not in all, by discharge from the urethra or vagina.

The *third* variety of condyloma is an ulcerated condition of the second. The condylomatous deposit has become a superficial sore, elevated and thickened by reason of its condylomatous substratum.

These varieties may be termed respectively—the *non-ulcerated venereal condyloma*, and the *ulcerated venereal condyloma*. I will not take upon me to affirm, that in every instance they are of venereal origin and character; but the succeeding observations will probably show that such is their usual nature.

Though each of these varieties slides into the other, and the two last offer palpable affinities, yet, for practical, as for theoretical reasons, it is advisable to consider them apart, and to study the features that each presents. But in this, as in many other instances, the precise delimitations of books may be disregarded at the bed-side; and the experienced surgeon, while he recognises shades of differences hard to be pourtrayed, sets their proper value on artificial separations of phenomena naturally connected. With this admission, which seems not uncalled for, I will endeavour to draw each variety of condyloma as closely as may be from the life.

1. SIMPLE CONDYLOMATOUS EXCRESCENCE.

This affects parts kept warm and moist, particularly if contiguous surfaces rub upon each other. Its favourite sites are the labia in females, and the perineum, or vicinity of the anus in both sexes. I have seen it in the groin, in the fold between the thigh and perineum, in the axilla, and between the toes. What is called "soft corn," is generally condyloma in the inter-digital cleft. It is occasionally seen between the nates of infants, especially of such as have been born of parents infected with venereal symptoms.

The growth is irregular—*not* attached by a pedunculated stem—of variable size, but frequently extensive[1]—fissured on the surface—sometimes, on the labia possessed of little vascularity, and almost lapsing into warts; generally, especially in the perineum and around the anus, vascular, though not highly so, and either covered with an adventitious mucous membrane, or actually ulcerated on the surface. Whether ulcerated or not, there is always a certain, and sometimes a profuse discharge of a watery character, of a sickly odour, and, occasionally, of a very acrimonious nature, excoriating the integument on which it flows. The parts appear in a continual slop.

The varieties in form, which are chiefly displayed in the perineum and round the anus, attracted the attention of the older surgeons, and gave occasion to some curious terms. The condylomatous productions received the absurd names of fici, cristæ, and so forth, from resemblances which they were supposed to exhibit to those objects.

On examining the structure of condyloma the cutis is found to be hypertrophied. Its vascularity is increased, materially in some instances, but not so distinctly in others; the subcutaneous cellular tissue evinces also a disposition to hypertrophy and condensation. The older the growth, the greater, in general, is the tendency to the predominance of a fibro-cellular structure, and to the diminution of the vascular organization.

The *causes* would appear sufficiently obvious. They are such as are calculated to give birth to excited action in the cutis.

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[1] Medico-Chirurgical Review, for July, 1834.

[1] I have seen the axilla *filled* with a mass of it, and it often forms a sort of collar round the anus.

Heat, moisture, and the lodgment of acrid secretions occasion it. Thus diseases of the rectum lead to condylomatous growths round the anus. We see it in filthy persons in the lower classes, independently of any venereal discharge; in females, it is seldom unaccompanied with leucorrhœa. It is a common sequela of chronic gonorrhœa.

No doubt the latter is both the most efficient and most frequent cause. It might, therefore, be supposed that simple condyloma has something specific in its nature, and ought to be regarded as venereal. But the following considerations are opposed to such a view. In the first place, condyloma often occurs independently both of syphilis and gonorrhœa; in the next place, it is commonly cured without mercury; and, in the third place, I have seen no reason to conclude that secondary symptoms are ever occasioned by it. Arising, as it does, from acrimonious secretions, we may readily admit its dependence upon gonorrhœa, without assigning to it a specific character. In this respect, it resembles intertrigo and warts, and all are, probably, generated in the same manner, and depend on causes intrinsically alike.

The *treatment* of the complaint comprises two items—prevention, and cure; prevention of all that excites the morbid growth; removal of that which has been formed.

The preventive treatment is simple and obvious. The secretions are to be corrected in point of quality; diminished, if excessive, in point of quantity; and the heat and moisture and friction of the parts concerned, must be reduced.

The means of improving the secretions require no lengthened enumeration here. But I may venture to observe that smart purging is generally requisite. Two or three grains of blue pill, with one of ipecacuanha, may be given every other night, and followed in the morning by a black draught, or by infusion of roses and sulphate of magnesia. A very efficient, and a very nasty, purgative is a combination of the sulphate and carbonate of magnesia, with the wine of colchicum, and pimento water. But if condyloma is situated at the margin of the anus, and depends on disease within the rectum, such active aperients are, of course, improper, and must be superseded by castor oil, or manna, or some other gentle laxative. The *warm-bath* is another remedy of great utility. That, or the simple vapour-bath, or, if both are un-attainable, the hip-bath, should be taken twice or three times a week. And the promotion of a free secretion of urine by salines with the nitrate of potass and a little antimony, or by the liquor potassæ, combined with the infusion of taraxacum has appeared to me to be of service.

In directing local treatment, there are two things to be kept in view; first, to restrain the vicious or inordinate discharge, which first gave rise to and afterwards perpetuated the condylomatous growth; and, secondly, to arrest the nutrition of the latter.

It is difficult to overrate the importance of the first step. We may employ escharotics of the severest sort, and inflict great pain with the knife or scissors, and yet make little real progress, if we leave the discharge that excites condyloma or warts to irritate or to regenerate them. A girl, in the Lock Hospital, had a formidable crop of vascular warts on the labia, nymphæ, and the perineum: for two or three months I was employed in excising them by liberal instalments, and applying caustic to the bleeding surface. Nothing could be more severe nor more inefficient than the treatment. Fresh verrucæ started up like hydras' heads, and the removal of one crop led to another, as bad or worse. During the whole period, the patient laboured under leucorrhœa, and used various injections for it. At last she was directed to throw up a strong solution of the nitrate of silver. This arrested the discharge, and the warts quickly disappeared. A short time ago, I was requested by Mr. Bushell, a highly intelligent medical practitioner, to see a lady who was under his care, and affected to a distressing extent with verrucæ. She was young, just married, of a stout and rather a sanguineous habit. The external parts were crowded with warts of a vascular character, and leucorrhœa existed. We had little doubt that the complaint arose from excitement of the parts, consequent on matrimony, in a plethoric state of the system. We agreed to keep the patient on moderate diet, to act freely on the bowels, to employ the lead injection, and to destroy the larger warts with the scissors or with escharotics. These means, however, were so painful, that the lady would not continue to submit to them, and, indeed, their effects were not so satisfactory as to lead Mr. Bushell to press their employment. They were abandoned, and the warts were simply treated with cold water, while vaginal discharge was repressed by injecting: under this plan the lady got quite well. It would be easy to mention other instances illustrative of the necessity of arresting or correcting irritating secretions, in order to control the growth of verrucæ or of condylomata.

On the whole, I am inclined to think that astringent injections into the vagina are preferable to stimulating ones. Those which seem to answer best are the injection of the acetate of lead in water, or in the decoction of poppies—or that of alum in decoction of oak bark. The former may be used of the strength of two drachms to the pint. The infusion of galls is open to objections on the score of cleanliness, and the other vegetable astringents, though useful, are not superior to the combinations I have mentioned. The injections of the sulphate or acetate of zinc, of the sulphate of copper, of the nitrate of silver, of the bichloride of mercury, have their advocates, and are, in certain cases, beneficial.

The removal of the condylomatous growths that exist, is, of course, an object of importance. The means must vary, with their site, their size, and even with their form. If limited in number, and attached by any thing like a narrow base, the most expeditious way to get rid of them is by excision. If more numerous and less pedunculated, complete exicion is hardly to be recommended, and the partial use of the knife or scissors, with the assistance of escharotics to the remainder of the growth, will usually be found preferable. When the surface invaded by condylomata is considerable, and they are not collected into a decided *tumour*, even limited excision becomes more questionable; unless a large proportion of the growth can be removed at once by the assistance of the knife, some applications calculated to destroy it are requisite. The arsenical lotion is very powerful and rather dangerous. The lotion of the bichloride of mercury, from half a grain to two or three grains to the ounce, is extremely valuable. The ancient combination of the powdered savine and ærugo acris will sometimes prove as good as any. The liquor plumbi undiluted, or not much diluted, is another application that answers in some cases. It is unnecessary to augment the list of substances of this description. The experience or the fancy of every surgeon can add to it; and each may have his favourite wash or ointment. So far as I have seen, the bichloride lotion is the most efficient, and next to that the lotion of the acetate of lead may, perhaps, be fairly placed. I should observe, that, in one or two cases, I have seen most benefit from the use of an ointment, consisting of two grains of the bichloride of mercury to an ounce of spermaceti cerate; while, in other instances, equal parts of the zinc and lead ointments have given most relief.

Whatever be the application selected by the surgeon, the parts should be well washed with warm water, or even with soap, night and morning, and the ointment or lotion should be constantly applied on lint. When the surface secretes, as it sometimes does, profusely, the lint must be frequently changed. Every care should be taken to prevent friction or even contact of two surfaces, and the temperature should be kept down by rest, and by such light clothing as may seem desirable.

It only remains for me to remark, in reference to this form of condyloma, that, while it is most rife in free livers, and in persons of a gross habit, or coarse skin, and bad secretions, it is also in them most difficult to be removed. Yet, with care and attention, this is always practicable.

II. NON-ULCERATED VENEREAL CONDYLOMA.

This variety, and the third, are sufficiently distinct from the preceding. No force is required to dislocate them from *that*, however artificial may be their separation from each other. The mere circumstance of ulceration existing on the surface, constitutes the principal difference between them, and it is only for convenience, and for accuracy of specification that they are divided.

The *second form of condyloma*, is a flat, superficial, nearly circular deposit in the cutis. It is soft and smooth upon the surface, is evidently vascular, generally of a pinkish, sometimes of a blueish tint, according to its locality and the vigour of the circulation; it varies in thickness, from that of a sixpenny to nearly that of a penny piece; in circumference, it seldom exceeds the former, and is often little larger than a split pea.

The situations in which it is observed, are such as are most favourable to the production and maintenance of heat and moisture, and to the lodgment of discharge from the urethra or vagina. On this account, it is more frequent in women than in men, as are all the varieties of condyloma. In females, we find that the lower half of the labia, especially their internal surface, the perineum, the nates where they meet each other, and are contiguous to the anus, and the thighs where they join the perineum, are the spots where condylomata luxuriate. In the male, the lower surface of the penis, where it hangs against the scrotum, and the sides of the latter opposed to the thighs, are the usual situations for their growth. In an out-patient of the hospital, so numerous were these productions on the scrotum, that it wore a ridiculous resemblance to those antique shields which are studded all over with bosses.

In either sex, this form of condyloma is attended with discharge from the urethra or vagina. It is probable, that such discharge is a necessary antecedent to it. The circumstances, the habits, and the conformation of the female render her more liable to profuse secretion from the genital organs, than the male; and in the lower class of women that infest the streets, this form of condyloma is extremely frequent. The accounts they give of their complaints can rarely be depended on, yet they usually admit that discharge preceded the appearance of the condyloma. But as the latter would seem to occur more readily in some individuals than in others, it may be presumed that, in them, the secretions are peculiarly acrid.

The obvious characters of the discharge which waits on condyloma, are those of chronic gonorrhœa. It is commonly yellowish, profuse, and thin. On examining women with the speculum, I have seen in addition to this discharge in the vagina, a thicker and more gelatinous semifluid mass proceeding from the os uteri. This mass makes its appearance externally, and is not unfrequently described by patients as a "lump of flesh." It is not peculiar to condyloma, but is observed in gonorrhœa; and indeed may occur in an excited state, however generated, of the uterus. In irritable females, it often succeeds the menstrual flux.

Of course, there is no reason why gonorrhœa, in its acuter forms, should not co-exist with condyloma. If it does, it must be deemed an accidental complication, and has been contracted during the presence of the latter.

Condyloma attends chronic discharge, is probably generated by it, and forms, perhaps, the link between those affections of the mucous membrane of the vagina and urethra, which seldom occasion secondary symptoms, and the sores which are so prone to do so. The study of condyloma seems to me to derive a large share of interest from this consideration: for, if it be correct, we find in condyloma a sufficiently powerful machinery for the constant production of specific sores, and an argument of no mean force in the hands of those who contend for the extreme antiquity of syphilis. It would be difficult to suppose that gonorrhœal discharges were not early fruits of promiscuous intercourse; and that uncleanly habits are not as old as the human race. These being given, may appear to leave the elements of venereal affections in all their usual forms.

The *treatment* of this variety of condyloma must be regulated by the same principles as those which have been dwelt upon already. Aperients, containing mercury, to increase and to improve the alvine secretions—a strict attention to the urinary and cutaneous secretions—the warm hip-bath, and cleanliness in every way—the correction and arrest of the parent discharge, whether urethral or vaginal—and, lastly, the removal of the actual deposits, are the principal indications.

It is not so easy, in every instance, to disperse the condylomata. It is singular that they yield with much more facility in some cases than in others. In the majority, they do not need, and probably would be little benefited by a course of mercury; but, occasionally, they resist all local applications, until the system has been submitted to its influence. This should be a last resort—invoked only when the surgeon is satisfied, that milder and local means are ineffectual.

Those local means may be glanced at. From the flatness of the deposits, as well as from their number, excision is, if not impracticable, certainly improper; the ligature cannot be applied, powerful escharotics are usually unnecessary, and, therefore, from the pain they occasion, reprehensible. The lotion of the bichloride of mercury agrees best in the majority of cases; sometimes the solution of the acetate of lead, of more than ordinary strength, applied on lint, or through the medium of bread poultices, is more comfortable and more efficacious; or, most benefit is derived from the zinc and lead ointment, or the black wash poultice, or the sulphate of zinc, or the chloride of lime. The weak ointment of the bichloride of mercury has proved an useful adjuvant, and I have seen advantage from that of the iodide of potassium. But, on the whole, when the condylomata are *not* extremely irritable, the bichloride lotion, and, when they *are* extremely irritable, the acetate of lead, are the remedies most to be depended on.

III. ULCERATED VENEREAL CONDYLOMA.

This, the third form under which I have ventured to describe condyloma, would appear to be an advanced degree of the preceding. It is distinguished from it by the fact of ulceration having taken place upon the surface; each condylomatous deposit is a sore.

On some, the ulceration is very superficial; the appearance being that of mucous membrane, or of fine and moistened cuticle; on others, there is distinct flat ulceration—and, on others, the ulceration may be rather cupped. The tint is generally red; seldom, save in the cupped ulcerations, yellow. The base, or substratum of all, is firm; for the obvious reason, that each is a condylomatous deposit. For the same reason, all are raised above the level of the neighbouring integument; all being, therefore, more or less "elevated sores." But the elevation depends on the existence of the condyloma, not on changes dependent on the sore itself—a distinctive fact of some importance.

The essential features of these condylomatous sores may be briefly recapitulated: their number, size, and situation, following the laws which have been sufficiently alluded to—their elevated character—the flatness of their surface.

They affect, at times, a peculiar form. A row of ulcerations may be seen on the free edge of either labium, extending from the upper to the lower commissure, corresponding very closely to each other, and looking not unlike a string of beads. This sore is usually small, not exceeding, perhaps hardly reaching, a couple of lines in diameter.

The ulcerated condyloma is palpably possessed of high contagious properties. Opposite surfaces infect each other; and, wherever the discharge descends, fresh sores commonly spring up. I have seen them, in uncleanly women, stretch in scattered order down the inside of the thigh, even as low as the knee. The bead-like ulcers on the labia are evidently dependent on the power of infection possessed by the discharge.

The ulcerated condyloma, like the other forms, is much more frequent in women than in men. It is found in a large proportion of the females received into the Lock Hospital.

It also resembles the other varieties in the profuse discharge, vaginal or urethral, that attends it. I have frequently examined, with the speculum, women who were labouring under it. In the greater number of instances, I have found no farther morbid appearance than a vascular state of the vagina. In some, I have observed the gelatinous or lymphlike uterine discharge; in some, an appearance of abrasion of the mucous membrane; in two, what looked exactly like condylomatous sores on the rectal side of the vagina; and, in two, what were the ordinary characters of syphilitic ulcers, with elevated edges and a hardened base, in nearly the same situation.

I presume that in many, if not in most, instances, the discharge and the condylomata stand in the relation of cause and effect to each other. But, being once produced, the condylomatous sores have, undoubtedly, the property of giving rise to fresh ones, both in the same and in other individuals. The facts which have been mentioned prove the first position. The second is established by artificial inoculation, as well as by experiments of a less premeditated character.

Case.—A gentleman, on the eve of being married, had connexion with a female. He had not incurred a similar risk for a long time previously. On the next day, he consulted me for what he considered an excoriation. The inner prepuce was rather abraded in the neighbourhood of the frænum. In the course of a few days, the abrasion was converted into a sore with a hardened basis, or rather cupped and yellow surface, and slightly picked, yet raised, edges — in short, what seemed a syphilitic sore. I requested an examination of the female. This she willingly granted, protesting the while that she was well. The labia and the inside of the thighs were studded with ulcerated condylomata, and a discharge in some quantity issued from the vagina. Nothing further was detected by the speculum.

In this instance, the condylomata gave rise to a sore very similar to the common syphilitic sore. Both patients were put upon a course of mercury, and both perfectly recovered.

In two cases, I have seen the ulcerated condyloma follow phagedæna. They are attended with features of sufficient interest, to induce me to take the liberty of introducing them.

Case 1.—A gentleman, on a provincial tour, contracted a sore on the dorsum of the penis. He consulted a surgeon, who assured him that it was not syphilitic. He continued his excursion; and, in three weeks after the appearance of the sore, returned to town. He then applied to me. The sore was of some size, irregular, jagged, with a hardened base, and elevated edges. It wore the characters of syphilis, irritated and inflamed by free living and exertion. I prescribed salines and purgatives, to get rid of the inflammatory action; and then, the sore maintaining its specific aspect, he was put on a moderate course of mercury. All went on well at first, and the sore had nearly healed, when, without apparent cause, it spread and assumed a phagedænic aspect. Mercury now evidently disagreed, and was, of necessity, abandoned. Slowly the sore improved, and was again almost cicatrized, when the scrotum and penis became red, a copious, offensive, watery, and acrimonious discharge was poured forth from their surface; and, speedily, this was studded with condylomatous ulcers. The irritation was excessive. Hot baths and the bichloride lotion did some good, but it was necessary again to give mercury, with caution, before the condylomata could be removed. No secondary symptoms followed.

Case 2.—A gentleman *noticed* a sore on the dorsum penis as much as six weeks after connexion. Soon afterwards he consulted me. The sore was nearly circular, elevated, with a hardened base, and a yellowish, spongy surface. It looked very like a specific sore, yet the history, on which I could depend, was staggering. After trying some other means to no good purpose, I prescribed a mild course of mercury. The mouth was speedily affected. The sore improved to a certain point—retrograded—threatened to be phagedænic. The mercury was abandoned, and gradually the sore healed. By this time, (between six and seven weeks had elapsed,) a cachectic ulcer appeared below the right knee. This healed under sarsaparilla and the iodide of potassium. Condylomatous sores now broke out on the penis and the scrotum, with common condylomatous excrescences around the anus, psoriasis diffusa over the whole body, superficial yellowish white ulceration on the tonsils, the anterior palatine arch and velum, and condylomatous-looking deposits, as well as yellowish fissures in the tongue. The smallest quantity of mercury aggravated these symptoms; sarsaparilla and the iodide of potassium disagreed, and the only treatment that proved of any service was the liquor potassæ, with infusion of taraxacum and salines, in connexion with the hot bath. The local remedies that answered best were the bichloride lotion and ointment to the condylomata, and the solution of the nitrate of silver and the linimentum æruginis to the tongue and to the throat. This gentleman, after many months' illness, got quite well.

These cases are curious, and different opinions may be formed upon their nature. In the one case, mercury cured these condylomata; in the other, they were cured without it. The latter case, indeed, appeared to me to be an instance of psoriasis and condylomata, produced by mercury in a person of peculiar constitution. Either it was so, or there were venereal symptoms in a habit that could not support mercurial action. Whichever may be the correct explanation, such cases are always tedious, generally unsatisfactory, and, to an inexperienced surgeon, perplexing, if not hazardous.

SECONDARY CONSEQUENCES OF THE VENEREAL CONDYLOMA.

The ulcerated condyloma would appear to be entitled to rank among the forms of syphilis; for it may be followed by unequivocal secondary affections[1].

1. *Bubo*

Is seldom noticed in the non-ulcerated variety of condyloma. But as that is an effect of chronic discharge, and as enlargements of the inguinal glands from irritation, whether of the neighbouring integument or mucous membrane, are very frequently observed, it cannot be a matter of surprise if bubo does at times occur. It seldom suppurates. But no important inference can be drawn from that; the suppuration of a bubo depending so much on the conduct and constitution of the patient, as well as on the treatment of the surgeon—circumstances foreign to the special properties of the exciting cause. (See Bubo.)

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[1] I would be by no means understood to say, that the ulcerated condyloma only is succeeded by secondary symptoms. The non-ulcerated form may give birth to them, too: but, so far as my observation has gone, the latter has not done so as often as the former.

In the ulcerated condyloma bubo is more frequent, and, apparently, more disposed to suppuration. The latter event, however, is uncommon, even in the class of persons received into the hospital, a class in whom every circumstance concurs to aggravate venereal symptoms.

2. *Ulceration of the Throat.*

The condylomatous sore has seldom existed for any length of time, without the occurrence of ulceration of the tonsils. This is usually of a well marked character. The tonsils are commonly enlarged, sometimes very much so. Their surface displays a peculiar whitish ulceration. For the most part this is very superficial; I have never seen it deep; occasionally, the ulceration is of a yellowish tint, with little enlargement of the tonsils; but the former condition is by far the most frequent. Such is the association of white ulceration of the tonsils and the condylomatous sore, that the surgeon may, in many instances, predict the one from examination of the other. I would beg to draw particular notice to this point; I am not aware that it has been dwelt upon by other writers.

Sometimes the soft palate displays the same kind of ulceration as the tonsils; it evidently does not go through the corium of the mucous membrane; it is disposed to spread, and is attended with so little pain, that the patient is often not aware of its existence.

This form of ulceration of the tonsils and the palate, though more frequently remarked in connexion with condyloma, than with any other primary symptom, is by no means restricted to the former. I have seen it follow sores of different characters; and it has occurred in persons who could not support mercury—nay, has seemed to be occasioned, or has, at all events, been aggravated by its use.

3. *Affections of the Tongue and Lips.*

These are not so common as the ulceration of the tonsils and soft palate.

I have observed two forms of affection of the tongue—varieties of degree, perhaps, rather than of kind. In one, the tongue has presented small, circular, or nearly circular patches, sometimes redder, sometimes whiter, than the other portions of the organ. In either case, the mucous corium is evidently thickened—partially denuded of its epithelium, when reddened—presenting a morbid state of it, when white. These patches of the tongue are sometimes tender—in general, the contrary. The red patches are most ripe on the dorsum of the tongue, near its centre; the white predominate at its sides and tip. The latter present very much the appearance of drops of wax having fallen and cooled upon the tongue. Both descriptions of spot are analogous to cutaneous eruptions, and resemble lepra or psoriasis guttata.

The other form of affection of the tongue I have seen but once, as a consequence of condyloma; although I have observed it several times in persons injuriously affected by mercury.

The tongue seems swollen, it may be much so—has an œdematous appearance, and is indented by the teeth—is fissured in various directions—is generally too florid, though occasionally blanched—and displays here and there yellowish white ulcerations, disposed simply in hollows or in clefts.

In a middle-aged female, who presented such a condition of tongue in connexion with condyloma, the inner surface of the lip was similarly altered; and the gums were soft, tumid, and partially ulcerated, too.

The *Affections of the Lips*, like those of the tongue, display grades of intensity. On the one hand, we may observe the lip a little swollen, and on it a superficial whitish ulceration, or merely a sort of whitish patch or two, as if the part had been touched with lunar caustic.

On the other hand, the lip may be much more extensively implicated. In a girl in the Lock Hospital, the lower one was double its natural size, pouting, and rather everted. The epithelium was whitish and opaque, and constantly separated in distinct scales. A superficial whitish ulceration was also observed here and there. The tonsils, in this case, were enlarged and slightly ulcerated.

4. *Affections of the Skin.*

The eruptions which are prone to follow condyloma consist of the exanthematous stain, of lepra, of psoriasis, and of desquamating tubercle. I would not be understood to contend that no other forms of cutaneous eruptions can occur. If the patient be broken down by mercury, the cachectic eruptions or ulcerations might present themselves. But, as far as I have seen, the affections alluded to are those which seem naturally consequent on condyloma, independently of the operation of powerful disturbing circumstances.

The Exanthematous Efflorescence or Stain.—It is usually of a yellowish tint, sometimes of a purplish brown. It is of variable intensity—in one instance being deep in colour; in another, almost imperceptible. It consists of patches of irregular form, and of small, though indefinite size. They are usually clustered. They are most apparent on the back part of the neck, on the breast, and on the lower part of the abdomen. The cuticle is slightly disposed to scale. There is no appreciable deposite in the cutis.

Psoriasis Discreta.—This closely resembles the common psoriasis guttata, save that it is rather more dingy in hue, and more disposed to give rise to a coppery stain. It consists of small, separate deposits in the cutis. They approach in size to split pease, are occasionally confluent, are flat, and desquamate upon the surface.

Lepra.—This has all the characters of the lepra venerea, so well described and so accurately figured by Bateman. It is unnecessary, at present, to describe it further.

Desquamating Tubercle.—This is a rounder and more bulky deposit than forms the psoriasis guttata. It feels like a flattened pea *in* the cutis, and forms an elevation *on* it. Its tint is more florid than that of psoriasis, and approximates to what painters call the " Indian red." It desquamates upon the surface[1].

The analogy between these four forms of eruption is evident from two circumstances: *first*, from their frequent co-existence, the same patient displaying two, or even all at the same time; *secondly*, from their succession, one very commonly following another. All, too, are characterized by a tendency to desquamation, rather than to the formation of vesicles, pustules, or crusts; and by deposition rather than by ulceration. A feature, this, of much significance, indicative of an affinity between the primary and secondary morbid actions; and, what is more essential, and, perhaps, more certain, indicative also of a state of constitution not materially depraved.

Treatment.—This is naturally divisible into that of the ulcerated condyloma, and that of the secondary symptoms.

For the former, a course of mercury is generally necessary. I would not be understood to affirm, that such a course is always indispensable. The condylomata *may* certainly be cured without it. But, in the majority of cases, it is both the most successful and most speedy plan, and, in careful hands, no mischief can ensue from it.

The principles which should regulate the exhibition of mercury will be considered at a future time. It is only necessary to observe, at present, that, prior to commencing it, the general health should be attended to. If the tongue is foul, or the bowels are not in order, aperients must be given; indeed, at the onset, they may almost always be prescribed with benefit. Pyrexia, if it exists, should be removed by diaphoretics and salines. As soon as the secretions are improved, and the general functions set in order, a mild course of mercury may be commenced. The blue pill or the mercurial ointment are the preferable forms; five grains of the former twice daily, or inunction of half a drachm of the latter, at night, are the usual dose. Mercury should never, in this nor in any other venereal disorder, be continued for any length of time, without the combination of tonics. Of these, sarsaparilla, good diet, and a moderate allowance of the stimulus to which the patient is accustomed, appear to be, in general, the best.

The local applications and management are simple. If the parts are inflamed, tepid bathing and bread poultices may be employed. When irritation is subdued, the black wash, on lint, or in bread poultices, is the best application to the sores; and, when these are healed, the bichloride lotion or ointment may be had recourse to.

The strictest cleanliness, frequent general or hip-baths, and appropriate injections, if urethral or vaginal discharges exist, are as requisite in this as in the other forms of condyloma.

It would forestal details more appropriate in another place, to discuss the treatment of the secondary eruptions. Suffice it to say, that they indicate and will yield to a judicious course of mercury. This requires to be backed by sarsaparilla, or by other tonics, as circumstances may demand; and the iodide of potassium is an useful adjuvant.

The white ulceration of the tonsils and the palate should be touched twice or thrice weekly with the nitrate of silver, in substance, or in strong solution, and a gargle of the bichloride of mercury may be very usefully added. The formula for the latter is: one grain of the bichloride to twelve ounces of water.

The reddish or white patches on the tongue may be treated in the same manner as the ulceration of the throat. Caustic is even more necessary for them than for the latter. The mild course of mercury usually agrees with both.

But the swollen and fissured tongue, with yellowish or sloughy-looking ulcerations in it, rarely, if ever, supports the mercurial action. I have seen very bad effects, indeed, from that, and a state of tongue induced of a highly unpleasant and intractable description. The same affection is, undoubtedly, in some instances the product of mercury itself. Of this I have seen sufficient proof to carry conviction to my mind, and to make me shun that medicine in such cases. Light aperients, tonics, including pure air, &c., sarsaparilla, the iodide of potassium, are the remedies from which most benefit will be derived. And these may be assisted by the use of caustic, or the linimentum æruginis, the mel boracis, or such other stimulating substances as will suggest themselves to the mind of the practical surgeon.

An apology, perhaps, is due for this account of condyloma. It is, probably, short enough for many omissions, and long enough for many errors. Such as it is, I present it, with the hope that it may lead to a more complete investigation of the subject, and may induce other surgeons to publish the results of their experience. If it leads to a careful study of the malady, and an accurate discrimination of its various forms, it will have served every end that its author could venture to aim at.

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[1] This notice is not intended as a description of the eruptions it refers to—*that* will be found under the head of SYPHILIS. The present allusion to them is merely for the purpose of rendering the account of condyloma more complete.

Bibliography. — *Werner*, De Condylomatibus. Berol. 1825. *Vossen*, De Condylomatibus Venereis. Berol. 1827.

(*H. J. Johnson.*)

CONGELATION, from *congelare*, to congeal, Lat., πῆξις, Gr. Under this head we intend to give an account of the local action of cold upon the living body, and the affections resulting from that action, commonly known under the name of Frost-bites and Chilblains. The class of injuries resulting from the local action of heat, and elsewhere treated of under the title of Burns, may be considered as the exact counterpart of those we are now to speak of. The two classes of injury are diametrically opposite to each other in so far as their exciting causes are concerned, for these causes are in their physical nature the very reverse of each other ; but they present a very remarkable, and, at first sight, somewhat surprising coincidence in the symptoms which they exhibit, the course which they run, and the modes of treatment best adapted for them. In a practical point of view the injuries resulting from cold are chiefly interesting in the higher latitudes, where they often demand the assistance of the surgeon ; but they sometimes occur in more temperate regions, and they possess everywhere a high degree of interest from the light which they reflect upon some of the most important doctrines of surgical Pathology.

I. GENERAL EFFECTS OF COLD.

Although our object is to treat more especially of the local effects of cold, it is impossible altogether to pass over the more general effects which it produces upon the system at large. A part of the body may be severely burned while the rest of the system undergoes no elevation of temperature, and escapes from all injury, except what results from its sympathetic connexion with the burned part. But from the medium through which severe cold is usually applied to the body, it is rarely a single part only that suffers. While the extremities of the body have their vitality altogether suspended, and the humours congealed within them, it is not to be expected that the more internal parts, although more tenacious of their animal heat, should altogether escape injury. The subtile influence of the cold penetrates to the innermost recesses of the body, paralyzing all the vital functions, or even extinguishing life. In ministering, therefore, to persons who have been exposed to severe cold, the duty of the surgeon is, not merely to apply remedies to the frost-bitten parts—he must attend also to the more general and, as it often happens, more urgent affection.

Among the general effects of cold it is by no means our intention to enumerate the many diseases of which cold is commonly recognised as an exciting cause. This indeed would be no easy task, seeing that there is scarcely a disease to which mankind are subject which has not occasionally, whether with or without reason, been regarded as originating in cold. The vicissitudes of heat and cold, the application of cold to the body when bedewed with perspiration, or exhausted with fatigue, or in the state of collapse after the excitement of dissipation, the partial action of cold as by means of currents of cold air playing upon a part of the body, while the rest of it is comfortably warm or over-heated—these are among the most common of the combinations of circumstances which excite the diseases referred in common language to the action of cold. There can be no better illustration of the innocuousness of even a very intense cold, if applied to the bodies of men in a proper hygeienical condition, than has been afforded of late years by Captain Parry's voyages, during which the health of his gallant crew continued in the most perfect state far within the arctic circle, and often exposed to a cold far more severe than that necessary to freeze the mercury in the thermometer. This intense cold did no harm, because there was no combination of other circumstances to render it pernicious ; and the mode in which Capt. Parry averted such combinations, by the judicious regulation of the moral and physical circumstances of his crew, constitutes not one of the least achievements of that intelligent and intrepid navigator.

There is, however, a certain degree of cold which of itself, and independent of all auxiliary influences, is capable of producing the most serious effects upon the human body : what that degree of cold is cannot be determined absolutely. It varies according to many circumstances, and more especially according to the laws which regulate the development of animal heat in the human body. The cold which would be borne with impunity by an adult might be fatal to a person of advanced age or to an infant. That which might do no harm to men in vigorous health, in high spirits, and plentifully supplied with nourishing food, would speedily overwhelm those exhausted by previous diseases or long-continued fatigue, depressed in mind, and in want of sustenance. Habit, too, is generally regarded as enabling the inhabitants of frozen regions to withstand cold more easily than the inhabitants of temperate or intertropical countries. The accuracy of this doctrine, however, has been contested by Larrey, whose opinion on the subject is entitled to deference, from his having had, during the disastrous retreat of the army of Napoleon from Moscow, opportunities such as never before occurred in the history of mankind, of observing the relative powers of enduring cold in men of almost every nation of Europe. According to Larrey[1], the Italians, Spaniards, Portuguese, and Frenchmen suffered much less from the cold than the Dutch, the Hanoverians, and the Prussians. Even the Russians themselves, he had reason to believe, lost more men in proportion to their number than the French. He further remarks, that of the Russian and Polish troops, those from the southern provinces suffered least. He infers from these observations, that the inhabitants of southern countries possess a greater power of resisting cold than the inhabitants of the north. The facts mentioned by Larrey are of high importance, whatever explanation is to be given of them. We may, however, be allowed to suggest, in reference to the influence of habit, that it is not quite correct to suppose that the inhabitants of northern countries, because their winters are long and severe, are, on that account, inured to the long continued action of cold. They spend their winters far less in the open air than in apartments artificially heated to a temperature far above summer-heat. We believe it will be acknowledged by every Englishman who has passed a winter in France or Italy, that he never suffered so much from cold in his own comfortable home, as he did in those countries, where good fires are unknown, and where the houses are constructed more with the view of admitting the refreshing breezes of summer, than to guard against the winter's cold.

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[1] Mémoires de Chirurgie Militaire, tom. 4me, p. 111. 136.

The symptoms of a general kind produced by cold are pretty uniform in character. Few people pass many winters in our own country without experiencing those which first occur—an intense sensation of cold with numbness and stiffness, chiefly felt in the limbs. If the exposure to cold be prolonged, the sensibility of the surface of the body is more and more impaired till at length the extremities of the limbs become quite insensible to all external impressions. As the sensibility declines, the limbs become more and more stiff, and require a greater effort to put them in motion. But the sufferer is little disposed to make any additional effort, for with the inaptitude to motion in the limbs there comes on an indisposition to make the exertion necessary to perform it. This indisposition to move soon passes into drowsiness, and so overpowering is the desire to sleep, that it cannot be resisted even by those who are perfectly aware that by indulging it their lives are placed in the most imminent danger, and that their only safety consists in moving about. As soon as sleep creeps on, the cold has secured its victim, who is no longer capable of any effort to save himself, and whose only chance of life depends upon his being rescued by others from his fatal lethargy. If left to his fate, the vital heat first forsakes the extremities of the limbs, which are completely congealed, and the cold encroaches nearer and nearer to the centre of the system. There is reason to believe, however, that the action of the heart is arrested before any considerable portion of the body is completely frozen, and most probably while the temperature of the circulating blood is not much reduced under 60° of Fahrenheit's thermometer. On the cessation of the contraction of the heart, all power of further resistance to the cold is lost, and the body, no longer animate, and only subject to the law of physics, speedily assumes the temperature of the ambient air, and becomes a rigid and frozen mass.

Occasional deviations occur from the regular course of symptoms which we have just described. Thus there have been instances of persons being buried in the snow, or otherwise exposed to the inclemency of the weather, without having experienced any tendency to sleep, although the cold has been so severe as to congeal the extremities of the body[1]. On the other hand, a state of complete stupor has been known to take place at a very early period, before the limbs had at all lost their flexibility, and while the current of blood, judging from the state of the pulse at the wrist, still continued to flow, although with diminished force, to the extremities of the body[2].

In speaking of the local effects of cold, we shall have occasion to distinguish a primary stage of torpor, or diminished action, and a secondary stage of increased action. A similar distinction, although for the most part much less remarkable, obtains with respect to the general effects of cold. On the sudden application of heat to the body, while benumbed with cold, a state of general fever comes on, sometimes accompanied with symptoms of congestion of blood in the brain or lungs, which proves suddenly fatal. "Woe to the man," says Larrey, in his account of the Russian campaign[3], "who, when benumbed with cold, entered suddenly a warm chamber, or approached too near the great fire of the bivouac. Either the benumbed parts were suddenly struck with gangrene, or the individual was all at once suffocated by a sort of turgescence, which seemed to take place in the pulmonary and cerebral systems, and he died as from asphyxia. Thus perished the apothecary in chief of the guard of M. Suveau. He had arrived at Kouno without accident, only his strength was reduced by the cold and abstinence; he was offered shelter in a very warm chamber of the pharmacy of the hospital: scarcely had he passed a few hours in this new atmosphere, when his limbs, which he no longer felt as part of him, became swollen and puffy, and soon after he expired in the arms of his son and one of his assistants, without being able to utter a single word."

Symptoms of re-action, somewhat similar, showed themselves in many of the French soldiers who perished by the waysides during the retreat. They were seized before death with a kind of idiotism, feebleness, or complete loss of sight, difficulty of articulation, and nasal or pulmonary hæmorrhagies. Even in this state they were under the direful necessity of continuing their march, or were dragged along by their comrades or friends till they either fell down quite dead, or were carried off in convulsions like those of epilepsy[1]. As these accidents occurred while the cold continued with unmitigated severity, it is obvious they could not be caused, as in the case quoted above, by an elevated temperature. In all probability, the re-action proceeded from the violent muscular exertion, so far beyond their enfeebled powers, which these unfortunate men were compelled to make, to avoid falling into the hands of an exasperated enemy.

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[1] Thomson on Inflammation, p. 624.

[2] Edin. Med. and Surg. Journal, vol. i. p. 302.

[3] Mémoires, tom. iv. p. 134.

II. LOCAL EFFECTS OF COLD.

Passing over, in the meantime, the treatment of persons labouring under general symptoms of congelation, we go on to remark, that while the whole system suffers from cold, particular parts are more especially liable to its attacks, and that they may even sustain severe injury, or have their vitality quite destroyed, while the general system is little, if at all, implicated in the affection.

The parts of the body which most frequently suffer from the local action of cold, are the fingers and toes, and more especially the tips of them, the hands and feet, or larger portions of the extremities of the limbs. The nose, the ears, the prominence of the cheeks, and the genitals are also frequently affected ; and in all these parts it is the skin and more superficial tissues which suffer most severely. With respect to the extremities of the limbs, as they are the parts most remote from the centre of the circulation, it may be presumed, that in them the animal heat is developed with least energy, and that to this circumstance their peculiar liability to frost-bite is to be ascribed. The other parts mentioned above, being nearer to the heart, do not suffer on account of the blood not being propelled with sufficient force into their vessels, but chiefly from their prominent, and, as it were, peninsulated situation ; and the same principle, it is to be remarked, applies in conjunction with that mentioned above to explain the rapid refrigeration of the limbs. It must be obvious that a projecting part is peculiarly exposed to the action of cold, because it is surrounded on all sides either with the external air or with substances which carry off more or less of its proper heat ; and, besides, it is almost entirely dependent on its own resources for its supplies of animal heat, receiving very little by diffusion from neighbouring parts on account of its limited contact with them.

In describing the local effects of cold, we shall divide them into primary and secondary. We shall begin with the most severe cases, in which the cold has been intense, and applied for a sufficient length of time to bring the exposed parts fully under its influence. We shall then advert to cases of a milder kind, or which, from the peculiar mode in which the cold has been applied, are distinguished by certain peculiarities of character.

Primary stage of Congelation, or stage of Torpor.

The description of the primary local effects of cold has been to a certain extent necessarily anticipated in describing its general effects upon the body. It has been already mentioned, that when any part of the body is exposed to a severe and continued cold, the sensation of coldness at first produced gives place to numbness, and that the numbness at length passes into total insensibility ; that at the same time the part feels stiff, and unable to move with its wonted freedom, and that the stiffness gradually increases to complete incapability of motion. These effects of cold are chiefly of a physiological kind, depending upon the powers of life in the part gradually diminishing, and ultimately being totally suspended. They are, however, accompanied by other phenomena which are chiefly or entirely physical. The temperature of the part gradually approaches to that of the surrounding medium. This depends at once upon the lowness of the external temperature and the feeble state of the vital processes productive of animal heat ; the quantity of heat produced in a given time being less than that subducted according to the laws which regulate the diffusion of caloric. When at length the vital processes in the part are suspended, the laws of physical nature are enforced without further opposition. A state of complete congelation ensues, the solids become rigid, the blood freezes in the blood-vessels, and all the other humours are in like manner congealed within their vessels or cells. The part no longer exhibits any signs of life. It is neither flexible by any internal power, nor, without injury to its structure, by external force. If a cut be made into its substance, no blood follows, and no pain is produced. In this state it has been aptly described as resembling more a fragment of a marble statue, than a portion of a living body.

As parts in a state of complete congelation exhibit no signs of life, a question naturally arises, whether they ought to be regarded as actually dead, or merely in a state of suspended animation, and still capable of having their vitality restored. With respect to some cold-blooded animals, it is well known that not only parts of them, but their whole bodies may be completely frozen, and, notwithstanding, that on being thawed to their ordinary temperature, they are found to have all their faculties entire, and appear to have suffered no inconvenience from the congelation. The common leech is an animal of this kind. When leeches are kept during the winter in a tumbler of water, it sometimes happens that the water is frozen into a solid mass, with the leeches in the middle of it, and yet, on melting the ice, the animals appear quite lively, and do not afterwards sustain any bad consequences from the confinement in their icy prison. The observations of Dufay establish the same fact with respect to the common water-newt[1]. It is not, however, to be inferred that all cold-blooded animals admit of being frozen with impunity, for the experiment proves fatal to the greater number of them[2]. Even a part of the bodies of many of these animals cannot be frozen without depriving the part of vitality, as has been ascertained by Thomson with respect to the limbs of frogs[3].

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[1] Larrey, Bégin, in Dictionnaire de Médecine, tom. v. p. 406.

With respect to warm-blooded animals, there can be no doubt that none of them ever survives the congelation of the whole body, and this remark applies in an especial manner to man, who can never have any considerable portion of his body frozen, and much less the whole of it, without loss of life, although some surgical writers have exercised their ingenuity in devising the means of remedying such accidents. On the other hand, it is quite certain that small portions of the bodies of warm-blooded animals may be frozen, not only without destroying the life of the whole body, but without permanent injury to the frozen part. This was first satisfactorily ascertained by the experiments of John Hunter on the ears of the rabbit, and the comb and wattles of the cock. By means of frigorific mixtures he froze those parts completely; on thawing them an attack of inflammation succeeded, but they recovered perfectly in about a month. The same principle obtains in the human economy, although we cannot speak definitely as to the extent of the parts of the body which have been known to be frozen and afterwards to recover. That an entire limb has ever been frozen and escaped mortification is in a high degree improbable; but that the extremities of the limbs may have been frozen, and afterwards have recovered, there is, we think, no reason to doubt, whether we found our opinion on analogy, or on the evidence derived from the records of surgery. We shall insert below a most interesting case, in which there appears to be satisfactory evidence of the hands having been quite congealed, as they continued to freeze the water in which they were immersed for half an hour after they were withdrawn from the cold, and yet both hands recovered, although not without mutilation.

We have described above the condition of parts of the body that have been completely congealed. Very often, however, the congelation is not complete in the rigorous sense in which the term is employed in physical science. Parts affected with such incomplete congelations have their vitality more or less impaired. They are observed to be unusually pale and somewhat shrunk in volume. They feel stiff, or rather, to speak more correctly, the parts in their immediate neighbourhood feel stiff, for the parts themselves are no longer felt as objects of conciousness, and are incapable of transmitting any external impressions to the brain. So little uneasiness do these congelations occasion, that the person affected is very often not aware of their existence until they are fortunately discovered and pointed out to him by others, so as to enable him to adopt the very simple means necessary for recovery. A fact in some degree analogous has been mentioned by Larrey and other observers. Soldiers exposed to severe cold during a winter campaign, never apply for the assistance of the surgeon while the intensity of the cold continues, but as soon as a thaw takes place, they present themselves in great numbers to be treated for their frost-bites[1]. One reason of this is, that, so long as the cold continues, the congealed parts remain in a state of torpor; and it is only when an elevation of temperature brings on re-action, that pain or other uneasiness is felt to induce the soldiers to apply for relief. There is, however, still another reason to be assigned, viz. that on the occurrence of a thaw, although the cold as measured by the thermometer is less intense, yet as measured by our feelings it is, according to universal observation, greater than before, and produces a greater refrigeratory effect upon the body. This is owing to the cold being now accompanied with moisture, which gives both to the air and to the half-melted snow a greater conducting power, and by soaking into our shoes and other coverings render them less efficient in retaining the heat of the body.

We shall hereafter point out the very close analogy which subsists between the phenomena of burns and those of the secondary stage of congelation. In the meantime we may remark, that there is no condition of burned parts at all corresponding to the primary stage of congelation. The moment a part is burned, that moment symptoms of reaction manifest themselves, unless indeed the heat applied has been so violent as at once to destroy the vitality of the burned part; but we never observe from the action of a burning heat any state of suspended vitality such as we have described as resulting from the action of cold.

Secondary stage of Congelation, or stage of Reaction.

The state of torpor, which we have described as induced by the local action of cold, and constituting what we have named the primary stage of congelation, is frequently succeeded by a stage of reaction, in which the vital functions of the part congealed pass from a state of inactivity to the opposite state of violent overaction or inflammation. To induce the stage of reaction an elevation of temperature is absolutely necessary; and it may be induced whether the heat is applied generally to the body or more immediately to the frost-bitten parts. There is no fact in practical medicine better ascertained than that the degree of inflammatory reaction which follows the state of torpor in a part that has been exposed to cold, depends altogether, or, at least, chiefly, upon the subsequent application of heat. All observers agree in proclaiming the extreme danger in all such accidents of a rapid transition from cold to heat. If a person has had any part of his body congealed or benumbed, and thereupon goes immediately into a warm room, or exposes himself to the heat of an open fire, it is quite certain that the frost-bitten part will either be at once struck with mortification, or will be affected with inflammation and all its train of consequences. Another person again, exposed to a like degree of cold with the former, will escape all bad consequences, merely by avoiding external heat, keeping himself in a cold apartment, and having the congealed parts rubbed with snow, or immersed in iced water, till their sensibility and flexibility are restored. Such observations naturally lead to the conclusion, that the affections which we name frost-bites are less the effect of the action of cold than of the subsequent action of heat. Larrey expressly states it as his opinion, that cold is to be considered as merely the *pre-disposing cause* of such affections, and that the *exciting cause* is heat suddenly applied to parts in a state of torpor from cold. We consider this reasoning perfectly correct, in so far as the great majority of frost-bites are concerned; but we shall hereafter point out certain cases to which it does not apply, as the reaction in the cases to which we allude succeeds immediately to the application of cold without any intervening torpor or subsequent application of heat.

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[1] Cuvier, Règne Animale, tom. ii.

[2] Spallanzani, Opuscles Physiques, vol. i. chap. vi.

[3] Lectures on Inflammation, p. 629. (We give this fact on the authority of Thomson, and not of Spallanzani, who is quoted by Thomson himself, because the experiments of Spallanzani, as we understand them, relate to the freezing of the entire animal, and not of single parts of it.)

[1] Larrey, tom. iii. pp. 61, 62.

Of the prominent symptoms which mark the secondary stage of congelation, we cannot give a more correct general idea than by inserting here the following history of a case narrated by Mr. Edwards, surgeon to the Hecla during Captain Parry's first voyage to discover a north-west passage from the Atlantic to the Pacific ocean:—

"A servant of Captain Sabine, in endeavouring to extinguish a fire which had accidentally broken out, exposed his hands in the first instance to the operation of considerable heat; he afterwards remained in the open air in much distress of mind at having been in some measure the involuntary cause of the accident, and was almost unconscious of the effects of a temperature of 43° to 44° below zero upon his naked hands. He was at length noticed in this situation, and sent on board. His hands presented a strange appearance; they were perfectly hard, inflexible, colourless, possessing a degree of translucency, exhibiting more the external characters of pieces of sculptured marble than those of animated matter. They were immediately plunged in the cold bath, where they continued upwards of two hours before their flexibility was completely recovered; the abstraction of heat had been so great that the water in contact with the fingers congealed upon them, even half an hour after they had been immersed. During the cold application a considerable degree of reaction took place, attended by acute pain, from which the patient became so faint and exhausted as to necessitate his being conveyed to bed. In less than three hours very active inflammation had supervened, extending high up the arm, and soon afterwards each hand, from the wrist downward, was enclosed in a bladder, containing upwards of a pint of a viscid serous fluid. There were, however, three of the fingers of one hand and two of the other in which the vesication did not form; they continued cold and perfectly insensible, and whilst arterial action was powerful as far as the first joints of these fingers, the vessels of their extremities were in a perfect state of collapsion. During the employment of antiphlogistic remedies to reduce the inflammatory symptoms, various stimuli were used ineffectually to restore animation to the fingers; when the inflammation began to subside a separation took place between the dead and the living parts, and eventually the amputation of them became necessary."

This case is not only important as exhibiting a faithful picture of the principal phenomena which mark the second stage of congelation, but likewise as affording an example of the resuscitation and ultimate recovery of parts of the human body which had been completely frozen, for that the greater part of both hands, and more especially the fingers, were actually frozen, does not appear to us to admit of doubt. The case is still farther remarkable as showing that very violent reaction may ensue, notwithstanding the most judicious treatment of the congealed part, in the primary stage, and as constituting therefore an exception to the principles which have been stated above, to apply to the great majority of cases of congelation, in which an immunity from subsequent bad consequences is the fruit of judicious treatment of the congealed parts, and the degree in which secondary symptoms occur is in proportion to the mismanagement in exposing them to heat. The peculiarity here indicated we shall afterwards endeavour to show to be owing to the *sudden* action of intense cold.

It will be remarked that the symptoms described above, as characterizing the secondary stage of congelation, present a striking analogy with the phenomena of burns. In both we observe inflammation, effusion, vesication, ulceration, gangrene, and mortification. These symptoms, however, in cases of burn, occur immediately after the application of the exciting cause without any intervening period of vascular inactivity. In cases of congelation on the other hand, there is almost invariably a stage of torpor of greater or less duration, which precedes the symptoms of increased vascular action. Another difference is, that we never have, as an effect of cold, the complete disorganization which we often see produced by intense heat, which chars the soft tissues of the body, or resolves them into their gaseous elements. With these differences it may be affirmed without any paradox that the local effects of intense heat and of intense cold acting upon the human body, are the very same.

In the simplest cases of injury from cold the stage of torpor is succeeded by a sensation of pricking and tingling in the affected part, which soon becomes accompanied with shooting pain, tumefaction, throbbing, and obscure redness. In more severe cases the skin acquires the permanent red colour of inflammation; serum is effused from its surface, and the cuticle is elevated in vesications. If the vesications contain a limpid fluid, there is less danger to be apprehended than when the fluid is dark-coloured and sanguinolent. In cases of the latter description the inflammation very often terminates in gangrene and mortification. It sometimes happens that the mortification is confined to the skin, which always suffers more from cold than the deep-seated parts. Thus the greater part of the skin covering the foot has been observed to slough away, leaving the parts underneath in the full possession of their vitality. In cases of more severe injury the sphacelation is not confined to the integuments, but pervades the whole tissues of the limb. Extensive ulceration often occurs in the seat of the vesications, or in the parts from which the sloughs have been discharged. The only other symptom which remains to be described, is one which occurs only in the worst cases, and which is not like those hitherto mentioned, dependent on an over-excited state of the vascular system. On the contrary, it depends on no reaction ever taking place in the congealed part, which is struck primarily with mortification, passing at once from the state of suspended animation to that of actual death. In the treatment of congealed parts it is always considered a good sign when pain and throbbing begin to be felt in them, and always on the contrary, a very bad sign when no sensation of pain or other uneasiness is perceived. In the latter circumstances it is to be apprehended that the congealed part has been struck with primary mortification, in which case the functions of the nervous and vascular systems, which the cold had suspended, never return, and the part in consequence continues devoid of all sensation and vital action, while the parts in the immediate neighbourhood are in a state of violent inflammation.

In certain cases of comparatively rare occurrence, the symptoms of re-action induced by cold occur immediately upon the application of the exciting cause, without the intervention of any primary stage of torpor. Such for instance, are the effects of applying to the unprotected skin a solid body at a very low temperature, and more especially a metal or other substance possessing in an eminent degree the power of conducting heat. At the moment of contact a severe burning pain is felt, and an immediate reaction ensues, the skin being blistered just as from scalding with boiling water. Captain Parry, during his residence in the neighbourhood of Melville Island, observed this effect to take place when the thermometer stood at — 24° of Fahrenheit's thermometer, and it must of course have been much more remarkable when the temperature afterwards fell to — 55°. "It now," says Captain Parry, "became rather a painful experiment to touch any metallic substance in the open air with the naked hand. The feeling produced by it exactly resembling that occasioned by the opposite extreme of intense heat, and taking off the skin from the part affected." (Parry's Voyages, vol. i. p. 212.) In the same manner the French Academicians relate that during their winter residence at Tornea in Sweden, the application of a glass to the lips in the act of drinking always brought away blood, owing to the sudden cold taking off the skin.

In our own country the temperature of solid bodies never sinks so low from the mere influence of atmospheric cold as to produce the irritant effects just described; but we can produce by artificial means a still greater degree of cold than was observed by Captain Parry. The effects upon the tissues of living animals of the most intense cold which our frigorific mixtures can produce, have not been investigated, but we are pretty well acquainted with the effects of frozen mercury, which must have at least a degree of cold equal to — 39° F. the temperature at which mercury congeals. On laying hold of the frozen mass a sensation of burning is immediately produced, and we are instantly compelled to toss the metal from one hand to the other, with the very same gesticulations as if we were handling a red-hot ember. Pellitan, by allowing the mercury to remain too long upon the same part of his hand, had an intolerable sense of burning produced, followed by inflammation. Last winter we proposed to avail ourselves of the local effects of cold, by employing it as a therapeutic agent, and had given the necessary directions for applying frozen mercury as a counter-irritant in a case of diseased hip-joint, at that time under treatment in the Glasgow Infirmary, but a sudden thaw prevented the experiment. Taking advantage of a few very cold days, attended with a fall of snow, which occurred at the end of October (1836), we had the experiment made upon a patient, likewise affected with morbus coxarius, and under the care of one of our colleagues who politely consented to the trial. Instead of using mercury, which would have been inconvenient from its melting during the operation, we employed a cylinder of iron, about eight inches in length and an inch and a half in diameter. This cylinder was in the first place cooled down to zero of Fahrenheit, by burying it in a mixture of salt and snow, and it was then transferred to a mixture of snow and muriate of lime, which, before being mixed, had been cooled by means of another frigorific mixture in which the thermometer indicated a cold of — 10° F. When the cylinder had been kept in the cold a sufficient time, a towel was wrapped round one end of it, and the other applied to the diseased hip, immediately behind the great trochanter. On removing it, after it had been applied some minutes, the skin presented a very extraordinary aspect. It had lost all trace of redness, and had very much the colour of white wax, and as it bore a circular impress, it seemed as if the iron had been employed to stamp its figure upon the substance just mentioned. The white part was intensely cold, hard, and rigid, so that no doubt remained on the minds of those who examined it, that the superficial tissues were actually congealed. These appearances speedily passed away, and the part became affected with inflammation, and more painful than during the application of the iron. The inflammation excited was only slight, but next day the pain of the joint was nearly gone, and in eight days the lad was dismissed cured, no other application than a blister having been employed. Several of the gentlemen who witnessed the experiment afterwards applied the iron to their hands. No pain was at first excited, but a burning sensation came on gradually, and in a very short time became so severe that the hand was suddenly withdrawn. It is clear from the preceding account that the iron had not been cooled low enough to cause immediate vesication, and that the effect produced was due to the iron being kept sometime applied, and thus gradually abstracting the heat and causing congelation. In employing cold, therefore, as a therapeutic agent, it may be applied either in a state of great intensity, when it will cause immediate vesication, or in a less intense state, when it must be kept longer applied, and will cause congelation of the tissues in the neighbourhood, and to form an eschar the cold must be followed up without a moment's delay by a warm poultice.

We have still to advert to the more slight affections, commonly known by the name of chilblains. These are characterized by symptoms perfectly analogous to those described above, as accompanying the stage of re-action, but of a less severe kind. The sudden and frequent transition from the extremes of heat and cold is the principal cause of chilblains, and the hands and feet are the usual seat in which they occur. Washerwomen and other persons following employments in which sudden alternations of heat and cold are unavoidable, are peculiarly liable to chilblains, and some individuals appear subject to them from a constitutional susceptibility of the skin to the influence of temperature. The affected parts are swollen, and have a livid red or purple colour, with a sense of itching heat and tingling, and occasionally shooting pains. The inflammation is of the chronic kind, often lasting many weeks, and sometimes a succession of chilblains occurs in different situations during the whole cold season. The cuticle often exfoliates, and in more severe cases the inflamed surface becomes chapped, and the chaps degenerate into indolent ulcers with an ichorous discharge, and little tendency to granulate or cicatrize. In the most severe cases of all, sloughing takes place, and the detachment of the sloughs is followed by ulcers of a similar character.

III. MODE OF ACTION OF COLD.

To explain fully the influence which cold exerts over the human body, it would require to be considered under two points of view. It ought, in the first place, to be considered as one of the physical influences which give to the climate of cold countries its peculiar character, and which, by being in habitual operation upon the inhabitants of those countries during successive generations, stamps a peculiar modification both upon their physical development, and upon their moral and intellectual condition. In this point of view, the action of cold has engaged much attention, and is alike interesting to the philosopher and to the physiologist. In the second point of view, the action of cold is interesting only to the physiologist, the subject of investigation being the immediate effects which a low temperature produces upon the whole body and upon any part of the body exposed to its influence. It is under this latter point of view that we propose here very briefly to consider the mode of action of cold, avoiding all vague speculations as foreign to the object of a practical work, and having for our sole object to refer the numerous phenomena described above as arising from cold to a few general principles which may render them more easily understood.

Cold has been regarded by some writers as a stimulant, and by others as a sedative. To us it appears that the whole effects of cold cannot be referred to a single mode of action, and we shall endeavour to show that cold acts differently, according to the mode in which it is applied ; that when applied suddenly, so as to cause a very rapid subduction of heat, it acts as a stimulant or irritant, and that when it is gradually applied, so as to cause a slow subduction of heat, it acts as a sedative.

The most powerful means which we possess of causing a rapid subduction of heat from any part of the body, is by the application to it of a very cold metallic substance. We have described above minutely the effects produced upon the sensation and vascular action of the part to which this application is made, and the conclusion which must be drawn, is that the sudden action of intense cold is immediately and unequivocally irritant. The irritation excited by cold diminishes as the cold is less intense. It also diminishes according as it is applied through a medium, of which the power of conducting heat is less perfect. Thus a bit of wood or fur is less irritant than a metallic body, although not less cold. In the same manner gaseous substances, like atmospheric air are less irritant than solids, but there is still reason to think that an intensely cold air may excite a direct irritant action in a part suddenly uncovered and exposed to its influence. Where the cold is not sufficiently intense to cause inflammation, it will still, when suddenly applied cause an increased vascular action, not incompatible with health. Of this we have examples in the redness, and throbbing of the hands after rubbing them with snow, or immersing them in ice-cold water, and in the general glow of heat diffused over the body after the shock of the plunge-bath. It is not improbable that in these and all similar cases in which there is a very sudden abstraction of heat, the immediate actions which ensue, ought not to be referred to the diminution of temperature, but to the powerful, and often highly painful impression produced upon the animal sensibility. In proportion to the degree of this impression on the animal sensibility, is the degree of re-action excited by cold; if the impression be gently excitant, cold acts as a stimulant, causing merely a re-action not incompatible with health; if, again, the impression amount to pain, cold acts as an irritant, exciting the morbid action of inflammation.

When we compare the local action of cold which we have just described, with the local action of heat, we cannot fail to perceive that they are perfectly similar. Intense cold suddenly and rapidly applied, causes a burning sensation, immediately followed by inflammation; in the very same manner the heat of boiling-water or any other degree of heat, not so violent as to disorganize the animal tissues, causes a sensation of burning, immediately followed by inflammation. The conclusion is inevitable, that the very rapid abstraction of heat, and the very rapid communication of it, as they produce the very same effects, must be held to exert the same kind of local action upon the body. Neither is there any good reason for regarding this conclusion as paradoxical, derived from the opposite nature of heat and cold. The same mode of reasoning would lead us to conclude, because oil of vitriol is an acid, and caustic potash an alkali, that, therefore, these substances as they are opposed in chemical nature, should be opposed also in their local action on the living tissues of the body. Experience, however, shows us that oil of vitriol and potash, notwithstanding the opposition in their chemical nature, exert the same local action on the body as irritants and caustics, and so also experience shows that heat and cold, notwithstanding the opposition in their physical nature, exert a local irritant action on the body which is the same in kind, and different only in degree.

When cold is not applied suddenly, but gradually, and for a length of time, the effects which it produces are very different from those described above. From the heat of the body being abstracted very gradually, the sensation produced is not sufficiently intense to prove irritant, and no re-action therefore immediately follows. But from the length of time during which the cold is applied, it is no longer confined in its effects to the superficies, but pervades the whole thickness of the part, gradually abstracting the vital heat. The effect of this gradual abstraction of heat is gradually to diminish vascular action, till at length the action of the vessels, and all the other functions of life are completely arrested, and if the cold be still longer continued complete congelation ensues. Cold, thus employed, instead of being stimulant or irritant, is of all physiological agents with which we are acquainted, that which in the most strict propriety of language merits the appellation of a sedative. Its sedative effects are most conspicuous when applied locally to single parts, but it exerts a similar sedative action upon the whole body.

When the gradual abstraction of the heat of any part of the body has been carried so far as to suspend completely all the functions of life, it is nevertheless perfectly ascertained that the vitality of the part may by judicious management be completely restored, and no serious consequences ensue. The violent re-action which so often takes place in such cases ought not, therefore, to be ascribed to cold, since it never takes place without the subsequent application of heat. We have already quoted the observation of Larrey, that cold is merely the predisposing cause of frost-bites, and that heat subsequently applied is the exciting cause. This observation is strictly correct with respect to cold applied in a gradual way, and it is by cold so applied that the great majority of frost-bites are produced.

The effect of heat in causing inflammation and mortification in parts that have been congealed, or benumbed by cold, has been variously explained. The difficulty is to understand why a slight degree of heat should produce such formidable effects. Some physiologists have contented themselves with saying, that in the debilitated state of the part a slight degree of the stimulus of heat will produce as much effect, as would require a very intense heat in the ordinary state of vigor. This explanation, however, is perhaps more specious than satisfactory. Most probably the effects of heat are to be referred partly to an action exerted on the general system, and partly to a peculiar action exerted on the congealed part. The effect of heat on the general system consists in restoring the vigour of the circulation; now it will easily be conceived if the vigour of the circulation be restored, and the blood impelled forcibly into a congealed part, while its vessels are still in an impervious state, that congestion, disorganization and mortification must be very likely to ensue. Still farther, cold applied to the congealed part itself produces an effect upon its tissues, rendering them prone to inflame and mortify. The nature of this effect we do not understand, but probably it has some analogy with another effect of heat, which has been often quoted to illustrate it. In cold countries it is well known, that fruit, fish, and other organized substances liable to putrefaction, if they have been congealed and suddenly heated, immediately putrify; but if they be thawed gradually, taking the same precautions as with respect to frost-bitten parts, they keep fresh, just as if they had never been frozen. It is at least not improbable that the same effect of heat upon congealed organized substances, which, if they are dead, renders them prone to putrefaction, may, if they are living, render them prone to inflammation and mortification.

From what has been said, it appears that the inflammatory affections resulting from cold are, in certain cases, produced immediately by the irritant action of sudden and intense cold, but that in the great majority of cases, they are produced, not immediately by the cold but by the subsequent application of heat. It only remains to remark that there are certain cases of a mixed nature, in which both causes may conspire to produce inflammation. In such cases the imprudent application of heat may greatly aggravate the inflammatory symptoms, but no prudence can avert such a degree of inflammation, as is the effect of the direct irritant action of the cold. This it is important for the practitioner to bear in mind, that he may not reproach himself without cause on the occasional failure of his best directed endeavours to keep down inflammation. The case of Captain Sabine's servant quoted above was of this mixed kind. His hands had been suddenly exposed to a cold of — 43° Fahrenheit, sufficient to cause immediate inflammation, but the continued application of cold by suspending the vital functions of the parts prevented all manifestations of reaction; no sooner, however, was the vitality of the parts restored than inflammation came on, notwithstanding the precautions employed to prevent it.

IV. TREATMENT.

1*st*, *Preventive Treatment.*—The preventive treatment which should be employed by persons exposed to a great degree of cold, consists in the use of the proper means for preventing the subtraction of the heat of the body, and for entertaining in a vigorous condition the functions concerned in the production of animal heat. For the first of these purposes the body ought to be protected by flannels, furs, and other articles of clothing which are bad conductors of caloric, and have been ascertained by experience to be the best defence from the cold. Of the means of accomplishing the second purpose, a full nutritious diet with a considerable proportion of animal food is the most important. If wine or any other stimulants be employed, they should be taken merely as cordials to assist digestion, and always in great moderation, for if they are taken in excess, so as to cause vascular excitement, a state of collapse succeeds, which has been found by experience to be in the highest degree injurious to persons exposed to severe cold. Drowsiness is another effect of the imprudent indulgence in the use of intoxicating liquors, which is much to be dreaded. Many of the soldiers that perished during the Russian campaign never awoke from the sleep that followed intoxication. Exercise is another most important means of keeping up the heat of the body, and warding off not congelation alone, but all the ailments that beset men exposed to great cold. It has often been found highly useful for persons suffering from cold to keep a watch over each other, so as to give timely notice of the occurrence of frost-bites, which as has been already remarked are frequently perceived by by-standers before the individuals affected are aware of their existence.

2*d*, *Primary stage of Congelation.*—The great principle which has been approved by all experience as answering best for the treatment of parts in the first stage of congelation, is to bring them back to their natural temperature in so gradual a manner, that while we restore the vital functions of the parts, we do not excite in them a dangerous over-action. With this view the frost-bitten parts are to be rubbed with snow or immersed in cold water, and if the cold to which they have been exposed has been very great, the water employed should be first cooled down to the freezing point by the addition to it of pounded ice or snow. These means ought to be continued till the natural softness and pliability of the parts, and if possible also their sensibility be restored. While we thus endeavour to re-establish the circulation in the frozen parts with as little over-action as possible, we must be careful not to allow our precautions to be frustrated by the injudicious application of the stimulus of heat in a general way, or by the more free use of internal stimulants than may be absolutely required. It ought never to be forgotten that there is such a consent throughout the various departments of the arterial system, that we will in vain endeavour to keep down the action of one part if we allow the rest to become excited. The practice of bringing persons in the condition we are now considering into a warm room, of placing them before a large fire, or of bathing or fomenting them with hot water, is uniformly followed by the most disastrous consequences. On the contrary, the patient ought to be brought into an apartment of which the temperatnre to the feelings of the by-standers may seem cold, for to him that will at first be a sufficient transition from the inclemency of the external atmosphere. In this situation the local applications recommended above ought to be employed, and the patient should not be permitted to breathe a warmer air, till the hardness and rigidity of the frost-bitten parts have been removed.

In the treatment of persons that have been found buried in the snow, or otherwise exposed to a severe and long-continued cold, we have not only to contend against the local affections of the limbs and other prominent parts, but also against the general sedative influence of cold. In such cases the patient is to be stripped of his frozen raiment, and the body carefully dried. Heat should be communicated by friction with flannel cloths, at first cold and gradually heated, or with the naked hand. To stimulate the heart and respiratory organs, spirits, liquid ammonia, or oil of turpentine should be rubbed over the pit of the stomach, and pungent fumes applied to the nostrils. As soon as the patient is able to swallow, a gentle warm cordial ought to be administered. We must not, however, forget the frost-bitten parts, but keep down the circulation in them as carefully as we excite it in the general system. These parts are therefore to be rubbed with snow, or immersed in cold water. We must also be careful not to restore such a degree of vigour to the general circulation as may be detrimental to the congealed parts. We must carefully balance between the two extremes of stimulating too much and stimulating too little. It may be affirmed in general, that the more slowly the circulation and the temperature of the body are restored, the less severe the subsequent local affections are likely to prove; but it must, at the same time, not be forgot that there is a risk of the patient never rallying from his state of torpor. In that case all subsequent affections become but of secondary importance, and we must employ whatever stimuli may be necessary to guard our patient against the more imminent danger which threatens him.

With respect to those rare cases, in which symptoms of general congelation show themselves in a high degree without any local affection, as soon as we have satisfied ourselves of the nature of such cases, by a careful examination of the parts usually affected with frostbite, we are to apply heat and other stimuli, as recommended above; only we may apply them with much more freedom, as there is no danger of any local injury being induced by over-excitement. There is nothing therefore to forbid us from stretching the patient before the fire, immersing the extremities in hot water, or employing any other of the usual expedients for communicating heat[1].

3rd, *Inflammation.*—When a frost-bitten part has passed through the primary stage of congelation without having its vitality destroyed, a certain degree of reaction always takes place, indicated by heat and throbbing; but if to these symptoms are joined a sense of burning and shooting pains, we have reason to apprehend the accession of inflammation, and our endeavours must now be directed to moderate and subdue the inflammatory action, as upon the violence of that action the issue of the case now entirely depends. The application of cold which in the primary stage was intended to prevent inflammation will now be of use in moderating it. The immersion of the part in cold water will therefore be usefully succeeded by the application of a cold lotion, whether consisting simply of cold water or of water mingled with spirits or vinegar, or holding sugar of lead in solution. It is a very safe rule to continue the cold applications so long as they continue to be grateful to the feelings of the patient; but the moment they excite chilliness and shivering they should be discontinued. The remedies which should be used in substitution vary according to the degree of inflammation present: if there be mere redness of the skin, cotton, or the linimentum aquæ calcis may be employed; and under these or any other bland application a cure will readily be effected: if there be vesication, the fluid contained in the vesicles should be let out by a small puncture, without removing the cuticle, which still serves as a protection to the irritated surface; if the vesicles be of moderate size, and the fluid contained in them pellucid, the bland applications mentioned above will suffice; but if, on the other hand, the vesications be larger, and more especially if the fluid be dark-coloured, and the skin beneath with a livid tinge, there will then be reason to apprehend sloughing, and hot dressings, such as the turpentine liniment, will be most advantageously employed.

The general treatment ought to be directed to moderate the febrile excitement by all means compatible with husbanding the strength of the patient. A mild nutritious diet generally constitutes the most important part of it, with laxatives, saline diaphoretics, and opiates, as circumstances may require. If, however, the inflammation be extensive, with a threatening of gangrene, and feebleness of the pulse, stimulants must be given at an early period.

When, in consequence of the imprudent application of heat to a person labouring under symptoms of general congelation, the brain or lungs suffer from the sudden reaction, the patient must be immediately removed into a cooler atmosphere; and if the symptoms are not immediately mitigated, blood must be taken from the jugular vein in such quantity as may be deemed necessary, but with a due regard to the enfeebled condition of the patient.

4th, *Mortification.*—As has been already mentioned, mortification takes place after exposure to cold, either immediately, the congealed part never recovering from the direct sedative influence of the cold, or not till after the accession of inflammation, which, as in other instances where it is violent, may terminate in the death of the inflamed part. These cases differ little from each other in the treatment which they demand. In both our attention must be directed not merely to promote the separation of the mortified part, but to moderate the intense inflammation going on in the living parts immediately beyond it. Stimulant dressings, with resinous substances and spirit of turpentine, are found to be the most useful applications. As the inflammation becomes more moderate, and the line of separation between the living and dead parts more distinctly marked, free suppuration comes on, to promote which, by means of stimulating poultices or of emollient poultices, alternated with hot applications, is found to accelerate the detachment of the sloughs. When mortification is not confined to the integuments, but has pervaded the whole thickness of a limb, the unassisted powers of nature are rarely sufficient to effect a cure, and amputation becomes necessary. Sometimes indeed, when the line of separation forms in the immediate vicinity of a joint, and the joint is of small size, as in the fingers and toes, the patient may be spared the pain of a regular operation, and the knife be employed merely to cut the ligaments and facilitate the removal of the dead parts. When again the line of separation takes place at a distance from the articulating ends of the bones, or although near a joint, if that joint be of large size, amputation is indispensably necessary, and it ought to be performed as soon as circumstances will admit.

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[1] Ed. Med. and Surg. Journ. vol. i.

The constitutional treatment of mortification, if the circulation be in a vigorous state, should be of the same mild antiphlogistic kind which we have recommended in cases of inflammation. Very generally, however, and more especially when the mortification is extensive, the pulse is feeble and rapid, with other symptoms indicative of depression of the vital powers. Wine, and other alcoholic stimulants, and opium are our principal remedies in such circumstances. The Peruvian bark or quinine may likewise be employed, although the surgeons of the present day have much less faith in the virtues of these medicines than their predecessors.

5th, Ulceration.—The treatment of surfaces in a state of ulceration constitutes the most tedious part of the duty of the surgeon, with respect to congealed parts, as well as with respect to those that have been burned, and in both cases the treatment is conducted on the same general principles. The superficial sores, which originate in the bursting of vesications, heal readily under any mild or gently stimulant ointment. The more extensive sores which originate in the detachment of sloughs, or which are formed by the confluence of smaller sores having different modes of origin, are sometimes exceedingly difficult to heal. They throw up flabby granulations, and show no tendency to cicatrize, while the strength of the patient is exhausted by the profuseness of the discharge. Resinous dressings, red precipitate, sulphate of copper, nitrate of silver, and compression by means of bandages, are among the most useful means of cure; and these must be directed and varied according to the usual principles which regulate the surgical treatment of ulcers. Sometimes a sore, such as we have described, occupies a limb in its whole circumference, and nearly in its whole length, although sores so extensive much less frequently arise from congelations than from burns. In such cases, if the strength of the patient is rapidly sinking, and no progress has been made in the cicatrization of the sore, amputation of the limb presents the only chance of preserving life, and we have, therefore, no hesitation in saying that it ought to be performed. The incision should, if possible, be made in the sound skin above the sore, but if that be impossible from want of room above, we do not consider the circumstance any insuperable objection to the operation, for we have known a cure effected when the flaps were partly in a state of ulceration, and even although the flaps should be ulcerated all over, still the wound inflicted may be very trifling when compared with the local disease which the operation has been the means of removing.

6th, Chilblains.—The preventive part of the treatment of chilblains is not the least important. Persons subject to them should have the parts most liable to be affected properly defended from the cold, and should avoid as much as possible all sudden alternations of temperature. On being accidentally chilled they should beware of heating the chilled parts at the fire; a much more salutary reaction will be excited in them by immersion in cold water, and afterwards carefully drying and rubbing them till the proper heat is restored. This practice, although somewhat repugnant to the feelings, will be found to be one of the most effectual preservatives against chilblains. Regular immersion of the hands and feet in cold water, followed by friction, will also be found useful in giving tone to the superficial tissues, and enabling them to resist the action of cold.

The inflammation which accompanies chilblains does not require the depletory treatment recommended in phlegmonous affections. Stimulant lotions, consisting of alcohol or oil of turpentine, either alone or holding resinous and other acrid substances in solution, are the best applications. When ulceration has taken place the sores will be found to heal most readily under stimulant dressings. It ought to be farther remarked that the immersion in cold water, recommended above as a preventive, ought not to be discontinued, either during the inflammatory or ulcerative stage of chilblains, for it does not in any way interfere with the treatment, but on the contrary accelerates the cure.

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(*Andrew Buchanan.*)

CONIUM. (Κωνειον, Gr.; *cicuta*, Lat.; *cicuta maggiore*, Ital.; *cigue grand*, Fr.; *conio manchado*, Span.; *Schierling*, Ger.) The pharmacopœial name of the officinal hemlock.

The classic celebrity and associations connected with the history of conium, will ever invest it with an interest which no other drug can possess. Linnæus and Lamarck were of opinion that it was the state poison of antiquity, by which the criminals at the Areopagus of Athens were put to death; and agree with Plutarch in attributing to it the death of Socrates and Phocion.

Although conium had been celebrated amongst the ancients chiefly on account of its poisonous properties, we learn, nevertheless, from the writings of Hippocrates and Galen, that it was employed as a medicinal agent in the earliest days of medicine. Our ancestors confined themselves principally to administering it externally, as a soothing and resolutive remedy; but we are informed by Saint Jeromy, in one of his epistles, that the Egyptian priests were in the habit of reducing themselves to a state of impotency by drinking daily small quantities of the juice of hemlock. Aretæus also mentions its power of tranquillizing and moderating the venereal passions.

In the last century, however, it was prescribed in Germany, in full doses, in cases of impotency; and, in proof of its efficacy in that disease, we have the following statement, by Bergius, an author of respectability:—"Impotentiam virilem sub usu conii curatam observavi, in viro quodam plusquam quadragenario, qui omnem erectionem penis perdiderat, postinde tamen plures liberas procreavit." The same writer also recommends conium in cases of leucorrhœa and of gonorrhœa. He says—"In leucorrhœa lotiones ex infuso conii multum levant, præcipue si usus conii internus iis jungatur. Gonorrhœas recentes cum pilulis conii, et infuso insimul largiter hausto, sæpissime intra mensem secure curavi; in gonorrhœis inveteratis conium cum mercurio sublimato conjungo[1]."

The employment of the officinal hemlock, as a therapeutic agent, had been long abandoned, and its name consigned to oblivion, when M. Reneaulme, a French surgeon, published some essays on its medicinal properties, and immediately afterwards (in 1760), Baron Stoerck instituted those experiments with conium, and certain other narcotic plants, the publication of which attracted, to these remedies the attention of all the physicians of Europe. By experimenting on animals and on himself, Stoerck proved that conium might be administered internally without any danger, and advanced the opinion resulting from his experimental investigations,—that, with the assistance of this drug, many diseases, and even those which had been hitherto regarded as irremediable, might be radically cured. The experiments of Stoerck were repeated in England, in Italy, and in France, but with results very different to those anticipated; and the extravagant opinions advanced in favour of the specific nature of conium were, by these impartial investigations, soon reduced to their proper standard. It is extraordinary how men of learning and sagacity, in every age, have allowed themselves to be led away from the paths of observation, or even of truth, by some fortuitous phantasy or illusion; and how a writer of such general accuracy and acumen as Van Swieten, could, not only believe, but promulgate as irresistible truths, the exaggerated and improbable statements of Baron Stoerck, is not a little to be wondered at. The former gives a long list of cures of "cancer," of "obstinate lues," of "arthritis," of "inveterate gonorrhœa," of "venereal scirrhous testicle," &c. &c. performed "by Stoerck's hemlock," and concludes his laudatory remarks by stating, that the use of cicuta has been remarkably profitable in venereal cases, which neither a salivation, other mercurial remedies, nor decoctions, could in any way subdue. Of late years, M. Récamier has extolled in equally unqualified terms the sanative powers of conium, especially in cases of cancer. He regards it as a decided specific for that disease, and states, in his "Researches on the Treatment of Cancer," that he has cured a great number of cases of cancerous engorgement, occupying various parts of the body, by the administration of the extract of hemlock. M. Récamier strongly recommends that a rigid abstinence should be observed on the part of the patient during the time he is taking the drug, to which circumstance, as M. Ratier pertinently observes, the boasted beneficial results of the exhibition of conium are perhaps mainly attributable.

Although we deny that conium is entitled to the character of a *specific*, or has any claim to the wonderful properties which it was reputed to have possessed, we by no means think it of little value as a remedial agent. There are many diseases, and stages of disease, for which it is peculiarly adapted as a *palliative* medicine. For which it is preferable, even to opium, as a narcotic and sedative, and over whose irritable and excitable nature it exerts a soothing influence which no other drug seems to possess. In the last stages of cancer and phthisis pulmonalis it will be found especially serviceable, in tranquillizing the nervous irritation attendant upon those conditions, and in lulling the pain more rapidly, and for a greater permanency, than any other medicine.

Sir Everard Home states, in his excellent treatise, that mild means have been employed in the treatment of cancer with great advantage, and adds—"The treatment in my own practice that calls forth this commendation, is the internal and external use of hemlock; and in proof of its palliative efficacy, in some cases where the medicine was left off, the symptoms became more violent, and, when resumed, abated. I have even prevented the operation when the day was fixed, and the patient lived for months under this palliative mode of treatment, without any progress of the tumour, and was carried off ultimately by epileptic fits." Hemlock has also been recommended in the hectic stage of cancer, in combination with iron, and, according to Justamond and Mr. Carmichael, of Dublin, has been found exceedingly serviceable in allaying the distressing pain in the lower part of the spine, hips, and shoulders, which attend the last days of the unfortunate patient.

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[1] Materia Medica e Regno Vegetabili, &c. by Petrus Jonas Bergius, Stockholm, 1782.

M. Gasc relates a curious and instructive case[1], in which a woman, aged sixty-seven, had for some time presented all the symptoms of a confirmed cancer of the pylorus, and was cured, in the course of ten days, by the employment of conium. The author judiciously observes, although the symptoms closely resembled those of carcinoma, and were treated as if they were really pathognomonic of that disease, they, in all probability, had been produced by an attack of cardialgia.

In cases of venereal nodes, attended with excruciating pain, in malignant sores, and in all instances where the primary disease has induced a high state of constitutional, as well as local irritation, the administration of conium is indicated. It has been strongly recommended in scrofula, gout, obstinate cutaneous affections, hooping-cough, rheumatism, engorgement of the lymphatics, organic lesions of the liver, stomach, and intestines, and in neuralgia; but in most of these diseases it has obtained a questionable reputation.

M. M. Chaussier and Dumeril have, in particular, recommended the exhibition of conium in cases of tic doulourcux; and M. Biett asserts that he has frequently administered that drug with success in neuralgia, more especially sciatic neuralgia; M. Guersent also bears testimony to the efficacy of hemlock in the latter affection.

The alleged anti-venereal powers of conium had also gained for it much attention at the close of the last century; and those who are interested in that point will find much curious information, and some marvellous cases of cure (?) effected by this remedy, in Van Swieten's Commentaries on the Aphorisms of Boerhaave. It is still occasionally prescribed for certain syphilitic symptoms; and Kluyskens regards it as a *specific* for those venereal ulcers which attack the toes. M. Biett was in the habit of frequently administering conium in secondary symptoms; but never with success, unless when combined with another preparation, more or less energetic. It is our firm belief, that, farther than allaying pain, and rendering the nervous system obtuse, no other merit attaches to the drug, either in syphilis or cancer; but as a narcotic and sedative, it has these advantages over opium:—Its action is more quick, its anodyne virtues more permanent, and it does not require to be so frequently had recourse to as that powerful medicine.

Therapeutic action.—Conium, belonging to the class narcotics, acts as a sedative on the nervous system: it assuages pain, and induces sleep. When given in moderate doses, it occasions dimness of sight, vertigo, cephalalgia, nausea, precordial anxiety, and, occasionally, some irregularity in the pulse. It acts on the skin by elevating its temperature, and increasing the cutaneous transpiration. The secretion of urine is also increased. If, however, the dose be increased, and continued for some time, it may produce a retention of urine, when that fluid will appear sedimentous and thick, and emit a nauseous odour.

Conium appears to exert, according to M. Soubeiran[1], a peculiar influence on the lymphatic system: it not only diminishes the secretion of milk, but also acts on the mammary glands, which it ultimately wastes away. If too long continued it deranges the stomach, and, like all other narcotics, its effects vary according to the constitution or idiosyncrasy of each individual; for example, some patients may commence with large doses without experiencing any inconvenience, while, on the contrary, others cannot take more than a few grains, without occasioning symptoms more or less troublesome or serious.

Where conium has been overdosed, and acts as a poison, its effects greatly resemble those produced by opium. The respiratory system is chiefly affected; the breathing becomes laborious; the pulse small, and beating scarcely thirty in the minute; the extremities become cold, the countenance bloated, bluish, and turgid with blood. A case of a soldier, who had partaken of soup containing hemlock, and died three hours afterwards, in whom all the foregoing symptoms were manifest, is recorded in Le Journal de Leroux, t. xxiii. Aggasson mentions the case of a man who immediately after taking the conium maculatum had his superior extremities violently convulsed, while the inferior limbs were completely paralyzed[2].

The most prompt means of abstracting the poison from the stomach must be had recourse to; and if the stomach-pump be not at hand, the strongest direct emetics should be administered; vinegar and vegetable acids are the best antidotes, as they greatly diminish the energy of the poison. Dr. Christison says[3] the activity of the alkaloid conia is not impaired, but rather the reverse, by neutralization with an acid. This is directly opposed to the opinion of Geiger, for he says, "its poisonous effect is greatly lessened by union with acids[4]."

Post-mortem examinations of the body display great turgidity of the vessels of the head, and a remarkable fluid state of the blood, which Dr. A. T. Thompson thinks is owing to some chemical influence of the conium, as a small portion of the infusion prevents fresh drawn blood from coagulating[5]. The stomach and intestines are distended with gas; the mucous membrane is covered with brownish spots, which appear gangrenous in some places; the lungs and pulmonary veins are, occasionally, gorged with blood; the heart is soft and flabby.

Conin, the alkaline substance which Brande has extracted from the juice of hemlock, possesses intense poisonous properties, somewhat analogous to those of *strychnine*.

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[1] Journal Générale de Médecine, vol. vii. p. 352.

[1] Dictionnaire de Médecine, tom. viii.

[2] Dict. des Sciences Méd., art. CIGUE.

[3] Trans. Roy. Society, Edin. vol. xiii.

[4] Magazin für Pharmacie, xxxv. 72 und 259.

[5] Elements of Materia Medica, &c. vol i.

Doses—mode of administration.—When conium is administered with a view to alleviate the pain and irritation attendant upon certain stages of syphilis and cancer, it is necessary to begin with small doses, and to increase them gradually until symptoms of poisoning begin to be manifest, or else little or no benefit will result from the exhibition of the medicine. The dose of the extract of the *recent* plant—the preparation ordered by the London Pharmacopœia—is from one to six grains, which may be progressively increased to thirty grains. This preparation is objectionable, on account of the difficulty of preserving it. Most of the extract of the shops is inert, or nearly so. "We were one day (says M. Orfila, Toxicol. Gén. ii.) in the shop of an apothecary who had several times furnished us with the extract of hemlock, which we had administered to dogs to the dose of ten drachms, without producing any serious effect. We endeavoured to prove to him that the medicine was badly prepared; and, in order to convince him effectually, we swallowed, in the presence of several persons who happened to be in his shop, a drachm of this extract (seventy-two grains) dissolved in two drachms of water. We felt no effect from it; whilst twenty or thirty grains of the extract, well prepared, would have proved fatal to us. Let it be conceived now what advantage a person is likely to derive from such an extract, who takes one or two grains of it per day, or even thirty or forty, with the hope of getting rid of a scirrhous tumour, or of any other disease." The extract has also been applied as a topical dressing to cancerous sores.

The tincture ordered by the Dublin and Edinburgh Colleges is a preferable form. The dose of the tincture is from x♏ to xxx♏ in any vehicle, provided it is free from acid which might neutralize the narcotic power of the medicine. Cullen, who preferred the powder, recommended large doses, observing, that the effects of the drug must be strongly marked, in order that it may prove efficacious.

Conium is employed externally in the form of cataplasms and plasters.

An ethereal solution of hemlock is occasionally inhaled with advantage in certain convulsive affections, and especially in asthma.

(*Thomas H. Burgess.*)

CONJUNCTIVA. See Eye.

CONTRACTION, in a pathological point of view, is usually employed to designate the anormal and permanent approximation of parts, the result of *contraction* of the various tissues; as of skin and fascia in the cicatrices of burns, of fasciæ, ligaments, muscles, and tendons, in many distortions of the frame. The term contraction has, however, an active signification; and should, therefore, be confined to the process by which the approximation, distortion, or shortening of parts is effected, and should not be applied to the passive condition of a contracted or distorted limb, for which the expression contracture is, in the present day, correctly substituted.—See Contracture.

CONTRACTURE. By a contracture is meant that abnormal permanent alteration in the relative position and form of a part, produced by contraction. — See the articles: Ankylosis (Partial), Club-foot, Club-hand, Malformation, Rachitis, Spinal Distortion, Wry-neck, as these diseased states include the more frequent examples of contracture.

CONTRE-COUP. (*Contra-fissura*, *contra-fractura*, *repercussio*, Lat.; *Gegenspalt*, Ger.) The solution of continuity produced in parts more or less distant from those on which a blow or shock has impinged. In its confined sense, this term would apply only to the solution of continuity of bony structures; as, for instance, when the side of a bony cavity opposite to the point struck, or any other point of the same cavity, which might be more feeble than that on which the force had fallen, is fractured. By extension, it is also applied to the ruptures or lacerations produced, by external violence, in the soft or parenchymatous tissues: as the brain, spinal marrow, liver, spleen, kidneys, &c. And this, it is easy to conceive, will happen whenever the whole of the force is not expended in the fracture of the more resisting structures, The excess of the momentum is then propagated from the bones to the softer structures to which they are contiguous; and in which, if it be still considerable, it causes commotion, or rupture. Both these effects of the shock may even be present at the same time; the vibrations of the concussion permeating the tissues of the organ in the mass, and producing a partial rupture of its substance at the same time. But the shock may be also communicated from an external body which is at rest, while the individual is in motion. The part which comes into violent contact may not suffer severely; but, if the motion be thus suddenly arrested, the internal parts which participated in the motion of the entire frame are pressed, bruised, or torn, more or less extensively, according to the velocity of the motion and the suddenness with which it has been arrested. The same thing happens in falls, when neither the bones nor their ligaments give way, the shock which results from the body coming into violent contact with the ground is transmitted to the contiguous organs, and lesions of the same kind are produced as if these organs were directly struck or torn.

In a fall on the feet, or on the buttocks, the violence of the shock is much diminished by the numerous articulations through which it is transmitted before it tells upon the viscera; but the structures entering into the joints themselves are thus often seriously injured. Many of the cases of white swelling and caries of the vertebræ have no other origin.

Comparatively, some organs are more exposed to lesions from this cause than others. The intestines, from their loose attachments and great lubricity, seldom suffer in this way, though it is stated that hernia has been sometimes thus produced. The lungs, also, from the great mobility of the walls of the chest, are well protected from this species of injury: the liver, kidneys, spleen, distended bladder, and impregnated uterus, are very liable, and the brain and spinal marrow most of all, to experience the bad effects of Contre-coup.—See Concussion and Contusion.

CONTUSION, (*contusio*, from the verb *contundo*, Lat.; *contusion*, *meurtrissure*, Fr.; *Quetschung*, Ger.) The crushing, or bruising of parts produced by the shock or sudden pressure of blunt, round, or broad surfaced bodies, without loss of substance, or apparent solution of continuity. When the bruise is accompanied by a breach of the skin, it is called a contused wound. Gun-shot wounds belong to this class. Contusions may be caused without the active intervention of external agents; the different organs of the body may bruise and fret one another by falls, for instance, as explained under the article Counter-Coup.

The extent and gravity of this sort of lesion vary exceedingly. Slight bruises are too trivial to be noticed, while in severe contusions, the parts may be crushed to a mere pap, or their vessels may be so torn as to give rise to extensive infiltrations or extravasations of blood, with consecutive suppuration—and even to gangrene and sloughing. It has often been a source of wonder to the uninformed, how a part of a limb broken up by contusion sloughs away, although the skin after the injury had appeared but slightly bruised. This has led to the notion of wounds produced by the wind of a bullet. To the surgeon who knows that the fragility of parts is relative to their suppleness, extensibility, softness, thickness, and resistance, the occurrence of such injuries is perfectly intelligible. Skin resting on cellular tissue yields readily, or slips under the contunding force, and thus remains comparatively uninjured; while the denser soft parts, more especially those in contact with bone, receive its full impetus and are bruised, crushed, and broken up. The effects of contusion, (which is nothing more than the sudden and injurious application of a mechanical force) vary also according to the directness, bulk, and power of the force, and the relaxation or rigidity of the parts at the moment of being struck.

A bruised part, or to speak more precisely, bruised integument, has lost its natural colour; it is livid, blue or black, and this arises from the lacerated vessels having poured out their blood in greater or less quantity. If the injury is limited to this, it is nothing more than a simple ecchymosis, and scarcely requires any treatment. But when the injury is more violent, the contused parts, muscles, vessels, and nerves, (when not at once disorganized,) become the seat of phenomena, which it is important to study. The first effect of contusion is pain, and difficulty or inability of motion in the part, followed by swelling, arising from the extravasation of blood and lymph. When the parts struck are totally broken up, a sensation of cold, heaviness, and numbness, rather than of pain, is complained of. In the former case, the secondary symptoms, when unchecked by active treatment, are inflammation and the formation of matter; in the latter, the mortification soon becomes manifest, and the patient succumbs, or the stricken mass is eliminated by the combined efforts of nature and art. Sometimes the gangrene is not the immediate result of the contusion, but is the consequence of the violence of the inflammation to which it has given rise. The most fortunate termination is that in which the effused fluids are taken up by absorption, and the formation of matter is prevented. When the bruised parts abound in vascular and cellular tissues, and the vessels broken are numerous, the extravasation is often very considerable, amounting to several pounds of blood; yet even the absorption of such large quantities may, under proper treatment, be effected. When the swelling and pain consequent upon severe contusions is great, the traumatic fever accompanying the inflammation often runs high, and requires the promptest measures to subdue it.

The swelling that takes place is not always equally diffused, being in certain situations checked and limited by the existence of aponeurotic expansions. Where the cellular tissue is loose and abundant, the blood is infused by infiltration, the pain arising from the distension is not considerable, and absorption takes place in general, sooner, or later. But on the other hand, where aponeuroses interfere, the blood is extravasated so as to form compact collections, the tension and pain are great, and the probability of the less favourable termination by suppuration much increased. Of the former, we have an example in the rapid and diffused swelling from a blow on the eye-lids; of the latter, in the hard circumscribed bosses on the scalp. Some of these, however, are hard at the circumference, while they are so soft and depressible in the centre, as to induce a doubt of the existence of a depression in the skull itself. The central softness, however, merely depends on the presence of effused blood. This sort of tumour is most frequent on the lateral regions of the cranium.

In contusions of the thick deep-seated muscles, of the buttocks, loins, hips, or thighs, the strong aponeuroses prevent the immediate formation of an ecchymose, there is dull pain, and difficulty of motion; the skin however, at length puts on the yellowish, livid, or mottled appearance, but according to the arrangement of the aponeuroses, this appearance may be manifested at more or less distance from the place of the contusion. Collections formed under such circumstances do not, however, always terminate, either by resolution, or suppuration. The walls of the cavity containing them sometimes degenerate, and their removal by excision or cauterization becomes necessary. The contused muscles themselves, too, may recover their functions but, slowly and in an imperfect degree; a consequence the more likely to result when any considerable branch of nerve has suffered from the lesion. Local incurable paralysis from severe contusion is not uncommon, and the author of this article has witnessed a case of permanent amaurosis from the pressure of the head in a wine-press.

Some of the injuries to internal organs from contusion are noticed in the articles, Contre-Coup, and Head, and need not be reproduced here. The lesions of the thoracic viscera comprise rupture of blood-vessels, or of the heart itself, aneurism, inflammation of the lungs, pleuræ, &c., palpitation, dyspnea, &c., with or without fracture of the ribs. Those of the abdominal viscera, which are produced more readily when these are distended, comprise rupture of the stomach, small and large intestines, bladder, gall-bladder, liver, spleen, mesentery and blood-vessels, as well as herniæ and the strangulation of herniæ already existing. Contusion of the genital organs gives rise in the male, to the total destruction or inflammation of the testes, to hæmatocele, or effusion of blood within the tunica vaginalis, to extravasation of blood in the scrotum, or urine by the laceration of the urethra; in the female, it may give rise to abortion, inflammation of the uterus, degeneration of the ovaries, The sloughing that occurs of the vagina and posterior wall of the bladder in long protracted labour from the pressure of the head of the child, producing vesico-vaginal fistula, is itself nothing else than an effect of contusion.

The contusion of joints, like that of large vessels, may be so completely destructive as to require speedy amputation. When less severe, the injury nevertheless demands the utmost care and attention in order to avert the prospective mischief of inflammation of the ligaments, of the synovial membrane, swelling and destruction of the articular cartilages, and the usual train of suffering that accompanies the successive disorganization of all the tissues of the articulation.

The bones and glandular tissues exhibit the bad effects of bruises, which, in the former produce osteitis and its consequences; and in the latter, the various degenerations to which these organs are liable, such as chronic enlargement, scirrhus, &c.

The skin, as has been already stated, often escapes with slight injury, but this is by no means the case, when it happens to be crushed between two hard surfaces. Of this, we have an instance in bruises of the integument of the shin, and of the sharp edge of the ulna. When completely disorganised, it is livid, inelastic, and insensible; after a day or two, spots of a greyish or dirty yellow colour appear upon it, and its separation from the living parts becomes gradually more and more defined.

The Diagnosis of contusion is in general easily formed; but the surgeon should not allow himself to be deceived by the blackness of the skin; for, if it be not deprived of sensibility also, it is not destroyed. The discoloration caused by ecchymose is diffused, presenting various hues, the deepest being at the centre.

Sometimes a tumour resulting from the effusion of blood from a contusion pulsates like an aneurism. The position of the tumour, the history of its formation, together with the possibility or otherwise of interrupting the pulsations, by making pressure on the vessel from which it would derive its supply, were the tumour really aneurismal, will remove any doubt as to its nature.

It is much more difficult to avoid the mistake of confounding the effusion of blood caused by a contusion, with a collection of pus. Here again the previous symptoms guide our opinions. If there have been no inflammatory symptoms, if the effusion be largely diffused, and not pointed, if the feeling of fluctuation be unequal, fluctuating freely where the extravasation forms a pool, and affording the feeling of pressing a sponge, where the blood is simply infiltrated, then we can at once feel assured that it is not an abscess, the fluctuation in which is equal throughout its entire extent.

Treatment.—When both the soft parts and bones of a limb are thoroughly crushed, there can be no hesitation as to the course to be adopted. The limb must be removed, and that, too, before inflammation sets in. It may, however, happen that the stricken limb, though cold, pulseless, and insensible, shows no symptom of crushing either of the hard or soft parts. Under such circumstances, Lamotte, who mentions similar cases, has recommended the employment of numerous scarifications, after which he applied stimulating poultices. In a day or two, the heat and sensibility returned, or if not, the symptoms of gangrene becoming manifest, the conduct to be adopted could be no longer doubtful.

The chief indications in treatment of contusions are, to oppose the progress of the effusion into the cellular tissue, to prevent or moderate the inflammation which may arise, and to promote the absorption of the extravasated fluids.

The first is effected by means of cold applications, (among which may be enumerated the vegeto-mineral water, the vinegar or camphor-water, alcohol and water, or common water containing salt, alum, nitre, muriate of ammonia, or the sulphate of iron or zinc in solution,) direct pressure, and absolute rest. The second, by general or local bleeding by means of leeches or scarification, fomentations, and the antiphlogistic regimen. The third, by blisters, embrocations, liniments, effusions of cold water, gentle frictions, or champooing and bandaging. If the tumour, after remaining in an easy state for some time, should all at once become hot and painful, the leeching or scarification must be again had recourse to, in order to prevent, if possible its degeneration into an abscess. If the means employed should not prove successful, an early opening of the tumour would be advisable, to prevent extensive destruction of the neighbouring cellular tissue, or the formation of troublesome sinuses.

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(*W. B. Costello.*)

COPHOSIS, *κωφωσις*, *surditas*, deafness. See Ear.

COPPER. (*Cuprum*, Lat.; Κυπρος, Gr.; *Cuivre*, Fr.; *Kupfer*, Ger.) The sulphate and subacetate of this metal are alone used in surgery. For the former, see Caustics. The subacetate, or, as it is called, *ærugo*, is employed as a detergent in association with ointments, or as an escharotic. The sulphate of copper is also employed in the treatment of purulent ophthalmia, as a collyrium, and as an injection in gleet.

CORECTOMIA, a name given by German writers to the operation of making artificial pupil by excision; from *κορη*, *pupil;* *ἐκ*, *out;* and *τεμνω*, *I cut.* See Pupil, Artificial.

COREDIALYSIS.—The operation for artificial pupil by separation of the iris from its ciliary attachment; from *κορη*, pupil; and *διαλυω*, I loosen. See Pupil, Artificial.

COREMORPHOSIS.—The operation for artificial pupil; from *κορη*, pupil; and *μορφωσις*, formation. See Pupil, Artificial.

COREONCION, (from *κορη*, pupil, and *ὀγκος*, hook,) a name given by the Germans to an instrument employed in the operation of making an artificial pupil, by separating part of the iris from its ciliary attachment.

Graefe's *coreoncion* consisted originally of a simple hook, provided with a guard which could be slid towards its point, or withdrawn from it, by means of a ferrule on the handle. At the opposite end of the instrument, there was a small knife for making the opening in the cornea. Graefe afterwards changed the simple hook for a double one made of hardened gold. He also added a spring by which the guard could be carried towards the point of the double hook, which was at the same time closed.

Schlagintweit's *iriankistron* [1] is an instrument very similar to Graefe's simple *coreoncion*, the principal difference being, that in the former the guard is received by the concavity of the hook, whereas in the latter it meets the point.

Langenbeck's *coreoncion*. This consists of a silver tube, like a pencil-case, which serves as the handle, and fixed to one end of it a fine gold tube about one inch and a quarter long. A steel wire, terminating in a fine hook, is enclosed within the gold tube, and being fixed within the handle of the instrument somewhat as a pencil is in a pencil-case, it admits of being protruded by touching a knob on the side of the handle. By means of a spiral spring within the handle, it is again drawn back. In this closed state the concavity of the hook is received by the edge of the golden tube, and its point thus kept so guarded that it is not apt to catch or wound any part by accident.

The instrument is introduced closed through the opening in the cornea into the anterior chamber, the hook is then pushed out a little by touching the knob on the handle, the iris seized, and then the instrument closed by allowing the spiral spring to act. The part of the iris seized is thus jammed between the edge of the golden tube and concavity of the hook. In this state the instrument is withdrawn, and along with it the part of the iris detached, which is left strangulated in the wound of the cornea.

It is to be remarked, that these and analogous instruments, called by different names, are quite unnecessary to the dexterous surgeon, and in the hands of an awkward person are not so manageable as the simple hook or forceps.

It is unnecessary to give figures of the instruments.

Bibliography.—Graefe's coreoncion is described in a small tract, entitled "Das Coreoncion, ein Beitrag zur künstlichen Pupillenbildung," Berlin und Leipzig, 1817, by Prof. Juengken; in "Hufeland's Journal," 1818, Mai; and in "Graefe und Walther's Journal," vol. iii. p. 135. For an account of Langenbeck's instrument, see his "Neue Bibliothek für die Chir. und Ophthalmologie," vol. i. p. 221. 228. 454. 676; vol. ii. p. 106, Hanover, 1818, 1819. See also "Mackenzie's Practical Treatise on the Eye," 3rd ed. p. 751, &c.

CORNEA, or *transparent cornea*, in contradistinction to the sclerotica, which has been called *opaque cornea.* L. *cornea* seu *cornea pellucida;* Gr. *κερατοειδης*; Fr. *la cornée*, ou *la cornée transparente;* Ger. *die Hornhaut* oder *die durchsichtige Hornhaut.*

The injuries and diseases of the cornea are, in every respect, worthy the careful attention of the surgeon, as even the slightest of them may prove a matter of grave consequence to the economy of the eye.

To understand properly the nature of the diseases of the cornea, and the cause of the differences which subsist among them, the anatomy of the part, both as regards structure and relations, should be well studied ; and this the more especially, when it is remembered that the cornea is a part through which, notwithstanding its delicacy and importance, incisions and punctures are often made in order to reach other parts of the eye which may be the immediate object of operation.

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[1] Ueber den gegenwärtigen Zustand der künstlichen Pupillenbildung in Deutschland; München, 1818.

ANATOMY OF THE CORNEA.

The cornea is at once a part of the strong outer tunic of the eyeball and a refractive medium. Though the surfaces of the sclerotica and cornea are not strictly spherical, still it may be allowable to state, in a general way, that the former is a large segment of a large sphere, and the latter a small segment of a smaller sphere. The diameter of the larger sphere, or that formed by the sclerotica, is the same as that of the eyeball in general, *i. e.* about $\frac{19}{20}$ of an inch. The radius of the convexity of the cornea is about $\frac{13}{40}$ of an inch. In a section of the eyeball, about $\frac{5}{6}$ of the circumference are formed by the sclerotica, and the remaining $\frac{1}{6}$ by the cornea.

The cornea is framed, as it were, into the front of the sclerotica ; but in order to meet each other, the latter inclines towards the axis of the eyeball, and the former in an opposite direction ; hence the slight sinking in of the surface all round the cornea.

In a section of the eyeball through the cornea and sclerotica, the edge of the former usually appears as if bevelled externally, and overlapped by the edge of the sclerotica, bevelled in the opposite direction. The edge of the cornea interiorly is, for the most part, also underlapped by a thin prolongation of the sclerotica.

The transverse diameter of the cornea, measured from the outside of the eye, is about $\frac{9}{20}$ of an inch, but the vertical diameter is somewhat less ; hence the outline of the cornea is rather oval than circular—oval, moreover, in the literal acceptation, as one end, that towards the temple, is smaller than the other. This form of the cornea is principally owing to the greater encroachment of the sclerotica externally on its upper and lower edges ; for when viewed internally, the circumference of the cornea is more nearly circular.

The cornea is about $\frac{1}{30}$ of an inch in thickness. In the adult, its surfaces are parallel ; but in the child it approaches somewhat to the form of a meniscus, while in old age it has a tendency to become concavo-convex.

We distinguish in the cornea three principal layers :—1st, the proper substance of the cornea in the middle ; 2dly, the conjunctiva corneæ in front ; 3dly, the membrane of Descemet behind.

The *proper substance of the cornea* may, by dissection, be divided into laminæ ; but this is merely artificial, as is proved by subjecting the part to maceration, when it absorbs water, becomes thicker, and presents a spongy appearance, but no trace of laminæ, properly so called. Moreover, microscopical observation shows it to consist merely of a felt-work of fibres, between the meshes of which is contained a transparent humour.

The cornea and sclerotica being both fibrous structures, present an interlacement at their junction, and the one is distinguishable from the other by the difference of transparency only.

The proper substance of the cornea is not rendered opaque by the chemical re-agents, which coagulate and whiten the epidermic part of its conjunctival investment.

Conjunctiva Corneæ.—The existence of an extension of the conjunctiva over the cornea has been a question with anatomists. That a layer may be separated from the anterior surface of the cornea, quite different from its proper substance, and apparently a continuation of the conjunctiva covering the sclerotica, no one has doubted ; but this layer does not present exactly the same, or at least all the anatomical and chemical characters as the sclerotic conjunctiva. It is not vascular, the vessels seen ramifying on the surface of the cornea in some inflammations being situated underneath it ; and it is coagulated and rendered opaque by boiling water or other reagent applied to separate it[1].

The following demonstration, I believe, is the true way of establishing the existence of a conjunctiva corneæ, and of preparing us to take advantage of the corroborative evidence afforded by morbid anatomy.

The layer above noticed as separable from the anterior surface of the cornea, consists of a fine epithelium, and a substance which may be compared to the corpus mucosum of the tegumentary system. Both these structures exist on the sclerotic conjunctiva, though the second is not so thick as over the cornea. The blood-vessels already mentioned, as situated underneath the layer under consideration, and in immediate connexion with the proper substance of the cornea, are derived from those of the sclerotic conjunctiva. They form a stratum, which, together with its support of delicate cellular tissue, must be considered as the essential elements of a chorion. We have thus a conjunctival layer of the cornea, but in a rudimentary state, or which, not admitting of being separated as a whole, in a distinct form like the sclerotic conjunctiva, may be viewed as composing, with the proper substance of the cornea, a fibro-mucous membrane.

What is called the *membrane of Descemet*, or *membrane of the anterior chamber of the aqueous humour*, lines the whole posterior surface of the cornea. Though it is often said to be reflected upon the anterior surface of the iris, it cannot, in the adult, be demonstrated farther than a little way upon its ciliary edge. When peeled from the proper substance of the cornea, the membrane under consideration curls together, and, if spread out and examined under the microscope, appears a homogeneous transparent substance. Its free surface is invested with a very delicate epithelium, composed of nucleated corpuscles.

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[1] The invalidity of the argument in favour of the extension of the conjunctiva over the cornea, founded on the *fact*, that in serpents a membrane is separated from over the eyes at the time of *casting the skin*, will be found fully exposed in the article "Lacrymal Organs," in the Cyclopædia of Anatomy and Physiology.

Blood-vessels of the Cornea.—The three structures of the cornea just described have a close vascular connexion with each other. Individually, the conjunctival layer has a direct vascular connexion with the conjunctiva, the proper substance with the sclerotica, and the membrane of Descemet with the iris. Around the margin of the cornea, the vessels of all these parts communicate.

The ocular conjunctiva receives its blood partly from the lacrymal, partly from the upper and lower palpebral, and partly from the muscular arteries. The fine twigs of these vessels in the part of the conjunctiva covering the sclerotica, affect a reticular arrangement, partly by crossing each other simply, and partly by inosculations. The latter is particularly the case around the cornea. It is only in the inflamed state that the vessels of the ocular conjunctiva can be well seen. In catarrhal ophthalmia, large superficial tortuous vessels are observed proceeding in a direction towards the cornea; a few of the same size are seen crossing these, especially at a distance from the cornea. Underneath the large vessels is a net-work of smaller ones, the branches of the larger. The blood-vessels having by subdivision become very fine, anastomose together by arches, and form, round the margin of the cornea, a vascular wreath or circle. From this, numerous twigs arise, and proceed, subdividing in their course, towards the centre of the cornea, into the proper substance of which they appear at last to penetrate.

In eyes in a state of congestion, I have seen, with the naked eye, blood-vessels in the cornea; but, in general, none are visible, except in inflammation, or in the early stage of development. It is sometimes only that the vessels of the conjunctiva corneæ are successfully injected.

The minute vessels, seen radiating towards the margin of the cornea, and forming the pink-coloured zone on the anterior surface of the sclerotica in internal inflammation of the eye, are the *anterior ciliary*. They are derived from the ophthalmic, lacrymal, supra-orbital, and muscular. Opposite the insertion of the ciliary ligament, they pierce the sclerotica and gain the interior of the eye, where, in the substance of the annulus albidus, they subdivide, and then enter the iris at its ciliary edge. Branches also penetrate between the proper substance of the cornea and the membrane of Descemet. The anterior ciliaries anastomose with the vessels of the conjunctiva, and, in penetrating the sclerotica, send twigs forward to the substance of the cornea. Within the eye the anterior ciliaries send a few twigs back into the choroid, to anastomose with the posterior ciliaries.

Nerves of the Cornea.—The existence of nerves in the cornea, as first pointed out by Schlemm, of Berlin, who traced branches of the ciliary nerves to it, has been recently confirmed by Bochdalek, of Prague, and Pappenheim, of Breslaw. The cornea, however, does not possess much sensibility. In the state of health it may be freely touched, or cut, or punctured with little or no pain.

The *relations* of the cornea to the aqueous humour and iris are points of great practical importance. Any perforation of the first involves the escape of the second; an occurrence, however, not in itself of serious import, except in as far as it favours the prolapse of the third, which, according to its extent, exerts a more or less prejudicial influence over the optical arrangement of the whole organ.

The motions of the iris are influenced by any irritation applied to the cornea. If the latter be touched with a stick of lunar caustic, for example, contraction of the pupil will be produced.

MALFORMATIONS OF THE CORNEA.

The cornea, though, for the sake of convenience in description, commonly said to be a segment of a sphere, is not so, strictly speaking; for it is slightly more prominent in the centre than a spherical surface would be. Moreover, its horizontal curvature has a somewhat greater radius than the vertical[1].

Marked deviation from this form of the cornea, gives rise to irregular refraction, and consequent disturbance of vision. The simplest and most common deviations consist in increased or diminished prominence of the cornea,—conditions, among others, of, in the former case, short-sightedness, and, in the latter, of long-sightedness. Other changes in the form of the cornea are met with, the most remarkable of which are cylindrical cornea and conical cornea.

Cylindrical Eye.

Mr. Airy has written an account[2] of one of his own eyes, which he ascertained to refract the rays to a nearer focus in a vertical than in a horizontal plane. This would take place, he remarks, if the cornea, instead of being a surface of revolution, in which the curvature of all its sections through the axis must be equal, were of some other form, in which the curvature in a vertical plane is greater than in a horizontal. This is, in fact, as has been above mentioned, the natural form of the cornea, but in the instance of Mr. Airy's eye, existing in an exaggerated degree so as to disturb vision.

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[1] Gerson, De Forma Corneæ Oculi Humani, &c.; Gottingæ, 1810, p. 21.

[2] Transactions of the Cambridge Philosophical Society, quoted in the Encyclopædia Metropolitana, article LIGHT, p. 398, § 359.

The following is a case of cylindrical deformation of the cornea produced by injury, but in a direction the converse of that presented by Mr. Airy's eye:—An angular fragment of iron, about half an inch long, chipped off by a chisel, penetrated the right cornea of Samuel Lamont, within a line of its upper margin. Though immediately removed, it produced cataract and dislocation of the lens, with very violent inflammation, which continued unabated for five weeks before the patient came to the Glasgow Eye Infirmary, notwithstanding blood-letting, leeching, and blistering. The lens was extracted by Dr. Rainy, with the same striking relief which extraction generally affords in such cases. The cornea, at his admission, was more convex in its horizontal than in its vertical section, as if it had been compressed laterally. This form, which it permanently retained, served materially to impair the patient's vision. The retina appeared to be sound, and he saw considerably more distinctly when he viewed objects through a four-inch convex glass[1].

With such unnatural conformation of the cornea, a point appears to the eye a line of a certain length; a circle an oval; every thing being seen elongated in one direction. The cylindrical deformation has been met with oblique, so that a square appeared a parallelogram.

The defect is remedied by glasses which, to the healthy eye, would make a line of the same length appear a point,—which would, in fact, shorten all objects in the same degree and in the same direction, as they were lengthened by the defective eye[2].

Each case of cylindrical cornea being thus more or less peculiar, lenses must be specially prepared for it; and it is evident that this demands both skill and intelligence on the part of the optician. The general principle on which the glass is shaped, Mr. Ross informs me, is this: One side of the lens is made a portion of a cylinder, of the same diameter as the cylinder cornea, having its axis, however, placed at right angles to that of the latter. The other side of the lens is made plane, convex, or concave, to suit the condition of the eye irrespective of its cylindricity.

Conical Cornea.

This change in the form of the cornea is not necessarily connected with any inflammatory symptoms, though in some cases such have been observed[3].

Objective Symptoms.—Along with disturbance of vision, the cornea is observed simply to become more and more prominent in or about the centre; and this prominence usually rises rather abruptly. When viewed from the front, the eye affected with conical cornea has a peculiarly brilliant and sparkling appearance, in consequence of the light being reflected in many different directions. Viewed in profile, the cornea appears dark between the apex and base of the cone. When the prominence of the cornea is considerable, the eye cannot be kept long and steadily directed forward, but is, by the action of the eyelids, always turned either to the one angle or the other. The apex of the cone in time becomes more or less opaque, and even ulcerated,—a state attended of course with some inflammatory action.

Subjective Symptoms.—Short-sightedness first attracts attention, and, by-and-by, vision becomes very indistinct at any distance. The patient can then recognize objects only when held close to the eye to one or other side, so that the rays of light may pass through the cornea as near its circumference as is compatible with their entrance into the pupil. In this state, half-closing the eyelids assists vision. The patient generally sees objects multiplied. This, Sir David Brewster ascertained to be owing to small inequalities on the surface of the deformed cornea.

Conical cornea is rather a rare affection. Females have been found more frequently the subjects of it than males; and young persons, than old. Though it occurs most commonly after puberty, Mr. Wardrop has met with conical cornea in a boy of eight, and Dr. Ammon once saw it congenital in three sisters. Both eyes usually become affected either at the same time or one after the other. Less commonly is the disease limited to one eye. For the most part, the cornea slowly undergoes the change to the conical form.

Diagnosis.—The morbid affections of the cornea, which might be confounded with conical cornea, are:—

1st. The spherically prominent cornea, occurring as a consequence of corneitis.

2d. Hernia of the cornea.

3d. Partial staphyloma of the cornea and iris.

4th. Conical staphyloma.

The characteristics of these, and their differences from conical cornea, will be pointed out in the proper place; here it is necessary only to remark that, as in the early stage the vivid reflection of the light is not apparent, the nature of the case may be altogether overlooked, if the practitioner does not take care to examine the eye from the side. Dr. Hull[1] mentions that he has known a practitioner prescribe at random for a lady, "who was obliged as she was leaving the presence, to inform him that her disorder was conical cornea!"

Morbid Anatomy.—Opinion has been divided on this point; some asserting that the centre of the cornea is thickened, others maintaining the contrary to be the fact. The late Dr. Jaeger, of Erlangen, examined the eyes of a person affected with conical cornea, who died of phthisis. The middle of the cornea forming the apex of the cone was in the right eye one-third, and in the left eye one-half thinner than natural. In both eyes the circumferential portion of the cornea was thickened. Mr. Middlemore has also had an opportunity of examining, after death, the state of the cornea in a person affected with the disease in an extreme degree. He found the circumference of the cornea of the ordinary and natural thickness, but its apex was much thinner than usual[1].

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[1] Mackenzie's Practical Treatise on the Diseases of the Eye, ed. 3d, p. 342; London, 1840.

[2] On the Use and Abuse of Spectacles, by Andrew Ross, optician, Regent Street.

[3] Figure 1.

[1] Cursory Notes on the Morbid Eye, p. 37.

The *causes* of conical transformation of the cornea are unknown.

The *prognosis* of conical cornea is in general unfavourable, though sometimes the disease, after a slight degree of development, has its farther progress arrested.

Treatment.—In entering upon this part of the subject, it is well to premise, that restoration of the cornea to its natural form is not to be calculated on. The only indications, therefore, are to arrest the deforming process ; or to try by an operation to rectify somewhat the disordered optical condition of the eye ; or lastly, to provide some kind of glass calculated to compensate the malformation of the cornea.

As a means of arresting the deforming process, counter-irritation, astringents locally, and tonics, or iodine internally, have had some equivocal testimony in their favour. So, likewise, repeated evacuation of the aqueous humour.

In a woman about seventy years of age, affected at the same time with conical cornea and cataracts, Sir William Adams successfully removed the latter, and found that the patient could afterwards see much more distinctly without convex glasses, than is usual for those who have undergone the operation for cataract. Encouraged by this, he removed the transparent crystalline lens, by the operation of division, from one of the eyes of a young woman affected with conical cornea in both. The ultimate result, he says, was beneficial. Others, however, assert, that the operation does no good, which theoretically was to have been expected, as a concave glass was likely to afford all the assistance which removal of the lens could by possibility do.

Dilatation of the pupil by belladonna has been found in some cases to assist vision. This it does by allowing the rays to enter the eye through the less deformed circumference of the cornea. On the same principle, Himly's operation of dislocating the pupil has been proposed ; and Mr. Tyrrell[2] informs us he has put it into execution seven or eight times within the last six years, and in each case with benefit, which in two especially was very considerable. In no instance did any evil follow. The operation consists simply in making a puncture, with an iris knife or the point of a cataract knife, through the cornea close to the sclerotica, and *prolapsing* a portion of the iris, so as to bring the pupil from behind the apex of the cone.

As to glasses, simple concaves have been found of no use. Dr. Hull mentions an instrument, formed of two lenses, with an adjustment, the farther and larger lens convex, the nearer and smaller doubly concave, from which benefit was obtained in as bad a case of conical cornea as he ever saw[1].

INJURIES OF THE CORNEA.

Foreign bodies adhering to, or imbedded in, the Cornea.

The husks of small seeds, and other analogous bodies, such as the wing-case of certain insects, and, as I have seen in a fisherman, one of the valves of a minute bivalve shell getting into the eye, sometimes adhere to the surface of the cornea, and are, perhaps, overlooked, until inflammation sets in, when they are mistaken for pustules or phlyctenulæ, resulting from the inflammation. This, therefore, should induce to a careful examination in any suspected case, when the nature of the body on the cornea cannot fail to be recognized. Removal is readily effected by the touch of a hair-pencil moistened and brought to a point, or of a toothpick, the eyed end of a probe, or a small spatula-like silver instrument for the purpose[2].

The ignited sparks detached from iron instruments in the course of various operations, called *fires*, and which so frequently strike, and sink into, the cornea, appear as small dark points on the surface, with some dimness around. They give rise to more or less pain, especially when the eyelids are closed, together with redness and lacrymation. The foreign body is, at first, firmly fixed, but afterwards becomes loose. When removed, it is found, on close examination, to be black oxyd of iron, fused into a minute globule.

Chips of pure metal, splinters of glass, stone, hard wood, and the like, projected against the eye, often stick, more or less deeply, in the cornea, or even wholly penetrate it, and lodge in the interior of the eye. If a part of the foreign body remains projecting, very great irritation ensues, but if the body has sunk fairly in the substance of the cornea, it may produce little reaction, or, becoming enveloped in a capsule of lymph, it ceases to be a cause of irritation, and the inflammation, to which it may have given rise, subsides ; the cornea at the part remaining opaque. More frequently, however, ulcerative absorption of the cornea takes place around the foreign body, which thus becomes loose at the bottom of the ulcer, requiring but a touch for its detachment.

When a chip of pure iron sticks in the cornea, and is allowed to remain any time, it becomes oxydated, and tinges the adjacent cornea of a brown colour.

The globule of black oxyd of iron is, in general, easily turned out of its nidus by means of the small silver spatula. If any part of a foreign body sticking in the cornea projects, it is to be seized with a forceps, and drawn out; but if it does not project, it is necessary to use a pointed instrument, such as a large, and rather blunt cataract needle, for its dislodgement. In doing this, great care should be taken not to cause any abrasion of the cornea, and never to scrape it, with the intention of removing, for instance, the brown speck left by the oxydation of a fragment of iron, such a speck it is well not to interfere with. When the foreign body is irregular in shape, and has penetrated the cornea obliquely, and to some extent, it may be necessary to make an incision with a cataract knife, so as to expose the body, which is then to be seized with a forceps, or turned out with the spatula. It is to be remarked, however, that when a body cannot be readily got at, attempts at extraction should not be continued too long, for more injury may result from this, than from the presence of the foreign body. By and by, it becomes loose, and is then more easily extracted.

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[1] Treatise, vol. i. p. 532.

[2] A Practical Work on the Diseases of the Eye, &c.; vol. i. p. 277. London, 1840.

[1] Op. et loc. cit.

[2] Figure 9.

Chemical Injuries.

That the eye can bear a great deal in this way is proved by the strong stimulants frequently applied to it by way of treatment, and by the circumstance that melted pitch, tallow, and even lead, have fallen into the eye without any very bad ultimate result. In some cases, however, the effects of such injuries are both severe and destructive.

When gunpowder is exploded into the eye, besides the burn which may result, the grains fix in the conjunctiva, and in the cornea, and unless carefully picked out with a small spatula, or the point of a cataract needle, the membrane will close over them, so that they will remain indelible, and the cornea become opaque[1]. It is generally the lower part of the cornea, Dr. Mackenzie remarks, p. 348, which suffers most from the explosion of gunpowder into the eye; but in an instance which came under his observation, as the person was in the act of stooping to the ground when the powder exploded, it was the upper half of each cornea that received the injury, and was left opaque.

Lime in any state, but especially when unslaked, getting into the eye, is very fatal to it. The cornea may be at once altogether destroyed, or, if the injury has not taken place to such an extent, the epidermic part of its conjunctival layer, at least, is immediately decomposed. It becomes white, rises in a blister, and, ultimately, peels off, leaving the proper substance of the cornea perfectly smooth, and presenting more or less of a blue pearly whiteness[2].

If the vascular stratum of the conjunctiva corneæ has not been injured, and if the inflammation which follows is moderate, the epidermic part is slowly regenerated, and the transparency of the cornea may be nearly restored. But if the lime has acted more deeply, or severe inflammation has ensued, the cornea never again becomes clear.

When sulphuric acid has been intruded into the eye, the conjunctiva appears almost scarred, being white, soft, and swollen. It afterwards peels off, while the cornea rapidly becomes disorganized, by infiltration of pus, ulceration and sometimes sloughing; a raw surface is left both on the ball and on the inside of the lids, ready to unite and close the eye, by an incurable and almost total symblepharon. In other cases partial symblepharon is the result[1]. Though the immediate effects of the injury may not be to such an extent as the above, Dr. Mackenzie remarks, that dangerous symptoms, such as onyx and iritis, are apt to occur, in such cases, weeks from the receipt of the injury. Symblepharon, to a greater or less extent, is also a common effect of injury from the intrusion of lime into the eye[2].

Abrasions, Contusions, and punctured and incised Wounds of the Cornea.

These may be all complicated with the injuries already described.

Though the surface of the cornea may be touched without inconvenience, a sudden wipe on it, with a handkerchief, for instance, causes considerable uneasiness, lacrymation, and intolerance of light for a time.

Abrasion of the cornea is sometimes produced by a scratch of the finger-nail, by awkward attempts to remove a foreign body, or it is the result of a stroke with an ear of corn, an accident to which reapers are much exposed. Sometimes the cornea is contused by a foreign body striking it, and then flying off.

The puncture or incision made in the cornea in operations generally heals soon and kindly; and even wounds produced by accident sometimes heal beyond expectation, though they are not unfrequently followed by severe and destructive inflammation. Such a result is readily accounted for by the contusion of the whole eye attending the accident, by the irregularity of the wound, perhaps a bad state of health at the time, and, not unfrequently, by the neglect with which the case is apt to be treated at first. If ordinary caution had been taken in the following case, it is not unlikely that the eye would speedily have recovered, as has happened in many similar instances.

A quarryman, young and healthy, was struck on the eye with a splinter of stone. The appearance I found, on examination, will, perhaps, be best described by saying, that the cornea was *cracked* in its vertical diameter.

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[1] Mackenzie, Practical Treatise, 3d ed. p. 227.

[2] Mackenzie, Treatise, &c.

[1] Mackenzie, Treatise, p. 226.

[2] See further on the subject, articles EYE and OPHTHALMIA.

At the place of the crack there was a slight tendency to project. There was no appearance of contusion, and no injection. So little inconvenience did this state produce, that the man could not be prevailed upon to intermit his work. The consequence was, that, in a day or two after, the projection of the cornea increased, the aqueous humour drained away, the iris fell forward against the cornea, and inflammation and pain set in.

The immediate effect, in most cases of penetrating wounds of the cornea, is escape of the aqueous humour, and, sometimes, especially if the wound is of any extent, and situated near the edge of the cornea, protrusion of the iris. It is this latter circumstance, when it occurs, which constitutes the principal difficulty of the case, for the mere wound of the cornea may heal, and the aqueous humour be renewed in from thirty-six to forty-eight hours. Even when the accident is quite recent, it is seldom we succeed in returning the iris to its natural position—never, if but a few hours have elapsed.

If the iris be but slightly engaged in the wound of the cornea, and if this be towards the circumference, the first thing to be tried is rubbing the upper eyelid over the cornea, and then suddenly opening the eye to a bright light. The tendency of the pupil to contract being thus excited, disengagement of the iris from the wound of the cornea is expected to follow. This proceeding may be repeated along with attempts to push the iris back into its place with a blunt probe. But, of course, all of this would be useless if the iris were at all strangulated in the wound of the cornea.

If the wound of the cornea be nearer the centre, and if it be the pupillary portion of the iris which is prolapsed, dilatation of the pupil by belladonna, prejudicial in the former case, may be tried in this, along with rubbing the eyelid over the cornea.

In regard to exciting the pupil to contract or dilate, it is to be remarked, that though the contractile power of the iris appears very considerable while supported by the aqueous humour, it becomes almost null when this is removed, in consequence of the resistance of its own weight, and the pressure of adjacent parts, to say nothing of its engagement in a wound of the cornea.

If protrusion of the iris be evidently kept up by the aqueous humour pressing it forward, this should be evacuated by puncture.

If the attempts to return the iris have failed, and if the case be still recent, the protruding iris should be snipt off with scissors, especially if it be the pupillary edge, and then friction employed as before. By this proceeding we may preserve the cornea entire, though with a pupil large and irregular. By leaving the protruded iris, synechia anterior and contracted pupil with opacity of the cornea to a greater or less extent, if not partial staphyloma, inevitably result.

If some time has already elapsed since the accident, the case falls into the category of ophthalmia, attended by penetrating ulceration of the cornea and protrusion of the iris.

When a wound of the cornea is healing, its edges are gray; but if, by any accident, union by the first intention should not take place, "the edges of the wound swell, and are separated from one another to a considerable distance by a tough yellow matter, resembling albumen, which sometimes hangs down from the wound in the form of flakes. As the healing process goes on, the quantity of this matter diminishes, and the edges gradually approach each other, until a firm and complete cicatrix is formed[1]."

It sometimes happens that in old and enfeebled persons, the incision made in the cornea for extracting a cataract does not unite, for want of sufficient reaction in the part: the consequence of this may be, that the aqueous humour drains away, the cornea becomes flaccid, dim, and gradually opaque, and eventually destruction of the eye follows. Sometimes the wound of the cornea does heal, after a considerable interval, and the eye is saved. In such cases nourishing diet and tonics should be given, and the eye itself touched with some stimulant, such as the nitrate of silver[2].

A penetrating wound of the cornea, close to its margin, sometimes closes by the conjunctiva alone healing over it while the proper substance of the cornea remains ununited. The consequence is, the aqueous humour elevates the conjunctiva in the form of a vesicle. This state of parts is called *fistula corneæ*, and must be distinguished from hernia corneæ and partial staphyloma.

After snipping off the elevated conjunctiva, the orifice in the proper substance of the cornea, leading into the anterior chamber, is to be touched freely with the lunar caustic pencil[3].

DISEASES OF THE CORNEA.

Inflammation of the Cornea, Corneitis or Keratitis.

As around the margin of the cornea, the blood-vessels of the conjunctiva, sclerotica, and iris communicate, and as from this vascular confluence the cornea receives its supply, it is not surprising that it should become involved in the inflammatory diseases of those parts, nor, on the other hand, that they should participate in inflammations primarily affecting it. But as the conjunctival layer of the cornea receives its vascular ramifications more particularly from the blood-vessels of the sclerotic conjunctiva, and the proper substance of the cornea, and membrane of Descemet, from the anterior ciliary arteries, which equally supply the sclerotica and iris, so each of the three component structures of the cornea may be separately affected by extension of inflammation from that part with which it has the most direct vascular connexion; though from the close anastomoses which the capillaries of one structure have with those of the others, all are apt to suffer.

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[1] Wardrop, Morbid Anatomy of the Human Eye, vol. i. p. 65, 2nd ed.

[2] Mackenzie, Treatise, p. 695; and Raleigh, Trans. of Med. and Phys. Soc. of Calcutta, vol. iv. p. 350.

[3] Mackenzie, Treatise, p. 335.

As it is with secondary, so it is with primary inflammations of the cornea;—its conjunctival layer, its proper substance, or the membrane of Descemet, may be the focus of disease, but the others will participate in its radiations to a greater or less extent.

Traumatic Inflammation of the Cornea.

In simple traumatic inflammation of the cornea, there is injection both of the sclerotic and conjunctival vessels, especially on that side of the cornea nearest the injured part. The only appearance in the cornea itself is opacity to a greater or less extent, and of a greater or less intensity. Vessels are seldom visible. The pain is slight, but is very severe if the inflammation has extended to the deeper parts of the eye.

By rest, cold lotions, and antiphlogistics, this slight degree of inflammation usually subsides in a sound constitution, and the cornea clears.

The result of injury of the cornea, however, even when trifling in degree, is not always so slight as above described. The inflammation is sometimes severe, obstinate, and dangerous, involving not only the cornea itself, but also other parts of the eye, both external and internal. The membrane of the aqueous humour is particularly liable to suffer; and iritis on the one hand, and inflammation of the proper substance of the cornea, ending in purulent infiltration, on the other, are not unfrequent complications.

In a man who had a glassful of ardent spirits thrown against his eye, inflammation of the membrane of the aqueous humour came on, but in a very slight degree. Dimness of the posterior surface of the cornea, most marked towards the centre, some discolouration of the iris, faint sclerotic redness, dimness of vision, and slight circumorbital pain, were the symptoms; but they passed off in a few days under the use of no other remedy but cold applications to the eye.

A severer form of inflammation from injury of the cornea is often met with in reapers, who have had the cornea abraded by a stroke from an ear of corn, though a similar inflammation often arises from other injuries. The patient presents himself to the surgeon with the cornea muddy and of a greenish yellow hue, the iris discoloured, and pupil contracted, with considerable conjunctival and sclerotic injection, such as is seen in catarrho-rheumatic ophthalmia. These objective symptoms are accompanied by fever, severe circumorbital or temporal pain, aggravated at night, and dimness of vision.

If the inflammation is allowed to run on, or if treatment fail to arrest its progress, purulent infiltration of the cornea, hypopyon, and effusion of lymph into the pupil, may take place singly or together. The ultimate result is loss of the eye, either by the bursting of the cornea and the formation of staphyloma, or by atrophy.

Treatment.—Mercury is our principal remedy, after the abstraction of blood. The extent to which venesection should be carried ought to be carefully regulated by the circumstances of the case; it is not to be dreaded too much on the one hand, nor, on the other, pushed, by repetition, too far. The pupil is to be kept dilated by belladonna, smeared on the eyebrow; and when the progress of the inflammation is arrested, the exhibition of bark, as a general remedy, and the application of a solution of corrosive sublimate, (gr. ſs—j—℥vij) with vinum opii (ʒj) as a local remedy, will powerfully promote the cure.

In illustration of the dangerous nature of the inflammation which is apt to take place in consequence of abrasion of the cornea in reapers, it is mentioned by Professor Walther, of Munich, in a small work, published thirty years ago[1], that, in the Isar district of Bavaria from fifty to sixty eyes used to be annually lost, during harvest, from this cause.

Inflammation of the Conjunctiva Corneæ.

In many cases of conjunctivitis, the conjunctiva corneæ remains quite unaffected; in other cases, the inflammation, sooner or later, spreads to it also. Sometimes, on the other hand, it would appear that the injection of the sclerotic conjunctiva is the consequence merely of the afflux of blood to the primarily affected conjunctiva corneæ.

Besides the cases of inflammation of the conjunctiva corneæ, attended with the formation of phlyctenulæ and pustules, ending in ulceration of the cornea, there are others, in which the conjunctiva corneæ, at some point, becomes opaque, thickened, and elevated merely, and receives from the circumcorneal conjunctival net-work a fasciculus of red vessels. The opacity and vascularity may gradually spread across the cornea. Such a case constitutes what Dr. Mackenzie describes under the name of *vascular albugo*. It occurs especially in scrofulous adults, and sometimes in children.

Certain inflammations of the conjunctiva, falling into a chronic state, are apt to become fixed in the conjunctiva corneæ. The cornea is then vascular and nebulous on its surface, or there are superficial ulceration, and, here and there, *vascular specks* or *real red granulations*.

In a practical point of view it is of importance to distinguish inflammation of the conjunctiva corneæ from inflammation of the proper substance of the cornea; for the former may be efficiently treated by local remedies which have no control over the latter. On the other hand, under the general treatment necessary for inflammation of the proper substance of the cornea, inflammation of the conjunctiva corneæ, when it has become chronic, is frequently found very stubborn, whilst, if a well-directed local treatment be added, the eye is often freed from vascularity, and the cornea cleared with amazing rapidity. Some spots of opacity usually remain, however; and it is to be kept in mind that relapses are very apt to take place.

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[1] Merkwürdige Heilung eines Eiterauges, p. 25, Landshut, 1810.

Treatment.—As the disease usually takes its origin in a scrophulous or scrophulo-catarrhal ophthalmia, the treatment necessary for the one or the other of these is what is required at the commencement. In the chronic state, the direct application to the eye of some strong stimulant, such as the nitrate of silver solution or salve, or the red precipitate salve, will be found of decided service. The salve is to be introduced under the upper eyelid, and diffused over the whole surface of the conjunctiva, by rubbing with the point of the finger over the eyelid. Two or three applications have frequently sufficed to remove the most marked appearances of the disease, such as the vascularity and red specks. For the dispersion of the opacities which remain, a solution of corrosive sublimate, with vinum opii, has been very serviceable. See COLLYRIUM. In addition to the local treatment, general treatment will often require to be directed to the regulation of the digestive organs and skin, and, if the patient be a female, to the re-establishment of the catamenial discharge. Nourishing diet and tonics are in most cases beneficial.

An enlarged state of the conjunctival vessels of the cornea (*vascular cornea*) is a not unfrequent appearance in chronic conjunctivitis. Though not always excited, it is kept up and aggravated by a granular state of the palpebral conjunctiva, a morbid condition which has resulted from the same inflammation which first gave rise to the vascularity of the cornea. The continued irritation from inverted eyelashes is also a very common cause of vascular cornea.

Treatment.—The source of irritation being removed, the vascularity of the cornea sometimes subsides of itself, or with the assistance of local stimulants, counter-irritation, and tonics, or good diet and change of air. Often, however, it persists, in spite of treatment, or, having been removed, readily returns.

Inflammation of the proper substance of the Cornea, Corneitis parenchymatosa.

Inflammation of the proper substance of the cornea appears under two forms. In the one, the morbid action is manifested only by its effects, which slowly ensue; in the other it is accompanied from the first by increased redness and other primary phenomena of inflammation in a more or less marked degree.

Though both forms are slow in their progress, the latter, as was to be expected, is much less so than the former; and if it leads more rapidly to a bad termination, it is sometimes also more rapidly arrested.

Objective Symptoms of the first form.—Though in the first-mentioned form of inflammation of the proper substance of the cornea there is no increased redness to attract notice, still, on close examination, the white of the eye will not be found so perfectly free of injection as in the healthy state, besides being dull and dirty looking.

The cornea appears simply interspersed with streaks or clouds of opacity, and unnaturally prominent, with corresponding enlargement of the anterior chamber. Sometimes it is of a slightly greenish yellow hue, and rough on the surface, like obscured glass.

Objective Symptoms of the second form.—In the second-mentioned form of inflammation there is distinct zonular redness of the sclerotica round the cornea, and the proper substance of the latter presents a grayish red opacity, interspersed with denser specks, inclining to yellow. The injection seen deep in the substance of the cornea, evidently does not come from the vessels of the conjunctiva; and the radiating zonular injection of the sclerotica is sometimes so slight as to warrant a doubt that the redness, so distinctly seen in the cornea, could be derived from it. But if we reflect on the circumscribed, and apparently detached redness of the conjunctiva, in pustular ophthalmia, produced by the confluence of a number of invisible vessels, there can be no difficulty in accounting for the injection of the cornea being derived from the slightly enlarged circum-corneal vessels of the sclerotica.

When injection of the conjunctiva corneæ is superadded, vessels from the circum-corneal net-work of the sclerotic conjunctiva encroach on some part of the margin of the cornea; sometimes all round, in the form of a red ring about one-twentieth of an inch broad. Sometimes, again, when the inflammation of the conjunctiva corneæ is more intense, the injection extends even to the middle of the cornea. In such a case, the superficial redness, thickening, and opacity may be so great as to conceal the state of the corneal substance. The affection of this, however, cannot be overlooked, if attention be directed to the increased prominence of the cornea and the attendant subjective symptoms, such as the intolerance of light, &c.

In this form of inflammation, exudation of lymph readily takes place into the substance of the cornea; but suppuration and ulceration are not so common as in the cases in which the cornea is secondarily affected.

Increased prominence of the cornea[1] is owing to softening of its texture on the one hand, and unusual accumulation of aqueous humour on the other; the latter resulting partly from the diminished elasticity and power of resistance of the cornea, and partly from increased secretion, as a consequence of accompanying aquo-capsulitis. It is distinguished from conical cornea by its spherical shape.

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[1] Figure 2.

Subjective Symptoms.—Dimness of vision first attracts attention. In the slighter form of the disease there is not much pain; perhaps, merely a feeling of distention, or of dull pressure on the front of the eyeball; and the eye feels weak. When the inflammatory appearances are marked, there is pain in the eye and head, with heat, intolerance of light, and lacrymation, to a greater or less degree; and, in addition to these, there are general feverish symptoms, especially at the commencement of the complaint, or when an exacerbation occurs.

Inflammation of the proper substance of the cornea is an obstinate disease. It may go on for a long time alternately getting better and worse. Aquo-capsulitis and iritis readily supervene, and the sclerotica, choroid and ciliary body may also become involved, in which case there is added to the increased prominence of the cornea a conical projection of the whole front of the eyeball, in consequence of an attenuation and yielding of the anterior part of the sclerotica, which also permits the choroid to shine through of a blueish colour. Under such circumstances, the retina has also suffered; and there are, consequently, more or less of amaurotic symptoms.

Predisposition.—The scrophulous constitution is usually well marked in the subjects of keratitis parenchymatosa, who are generally of an age from eight to eighteen, and more frequently females than males. In females, disturbed menstruation often accompanies the complaint. In adults, the disease occurs with a rheumatic character.

Causes.—The disease sometimes supervenes to another ophthalmia. External violence, or cold and wet, often appear to be the exciting causes. Sometimes the inflammation comes on after the retrocession of an affection of the skin. Often the etiology is obscure.

Prognosis.—When the inflammation can be arrested, the cornea clears sometimes very rapidly, and to an extent not previously expected. The clearing of the cornea takes place from the circumference towards the centre, where opacity usually lingers, and too often continues fixed. Increased prominence of the cornea, having once taken place, is permanent.

Frequent relapses are apt to discourage patient as well as practitioner.

The supervention of puberty or the restoration of regular menstruation in the female, may be expected to have some beneficial effect.

Treatment.—Good air, moderate light, attention to the state of the skin by tepid bath and friction, comfortable clothing and simple nourishing diet, are important dietetical adjuvants.

Emetics and purgatives will usually be found useful at the commencement of the treatment. A carefully-conducted alterative course of mercury, along with or followed by quinine or other tonics, such as iron, baryta, &c. will then prove of great advantage.

Abstraction of blood is not often necessary; but counter-irritation will generally be found useful. Blisters over the eyelids have been highly talked of.

Steaming the eyes with hot water, into which some of a spirituous solution of extract of belladonna has been put, is of great use in soothing the eye, and mitigating the intolerance of light. Belladonna is also sometimes necessary for the purpose of keeping the pupil dilated when it is feared the iris has become affected.

The only admissible wash for the eye is tepid water impregnated or not with poppies, hyosciamus, or belladonna; but when the disease has been fairly arrested, the corrosive sublimate solution, with vinum opii, or the latter alone, does good.

Evacuation of the aqueous humour is sometimes of at least temporary use, especially in chronic cases with great distention of the cornea.

Dr. Hull[1] of Norwich has found turpentine in corneitis, as in iritis, frequently a very efficient remedy, either alone or in alternation with mercury. He finds that in slow cases, Mr. Carmichael's ordinary dose, ʒj thrice daily, suffices; otherwise ʒj every few hours; or ʒij may be most efficacious. He finds the turpentine most easily taken "floating on water, or weak hollands and water, or diluted gin;" and he has remarked that "children bear the remedy best; even occasionally in doses, from which the stomach of the adult revolts."

For Inflammation of the Membrane of Descemet, see Article AQUO-MEMBRANITIS.

Abscess of the Cornea.

In various inflammations of the eye, especially when of a severe form, or neglected, the proper substance of the cornea is apt to become the seat of purulent deposit. This, which often takes place suddenly, and without any previous appearance of inflammatory action in the cornea itself, is always a threatening symptom, because extensive destruction of the cornea by ulceration and sloughing is very apt to be the result.

The lower part of the cornea is the place where deposition of matter most usually occurs. Such deposition, on account of its presenting the form of the lunular spot at the root of the nails, is called *unguis* or *onyx*. An onyx, and a collection of matter at the bottom of the anterior chamber, which is called *hypopyon*, are distinguishable from each other by the following circumstances. The upper edge of the former is convex, that of the latter straight or even concave; but the principal difference is that the matter of onyx is immoveable, while that of hypopyon is displaced by turning the patient's head to one or other side. Lastly, on looking at the cornea in profile, the deposition in onyx appears nearer the surface than that in hypopyon. Both onyx and hypopyon, it is to be remarked, however, may exist at the same time.

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[1] On the Morbid Eye, pp. 52,53.

Circumscribed collections of matter sometimes form in the centre of the cornea, and these are perhaps more deserving the name of abscess than any other deposition. They appear as a yellow spot, around which the rest of the cornea is opaque, from an effusion of lymph, such as takes place in the walls of other abscesses.

Central abscess usually occurs as a consequence of acute ophthalmia, such as variolous or catarrho-rheumatic; but it is occasionally met with, in exhausted states of the system, unaccompanied by any severe inflammatory action.

The whole cornea again may become infiltrated with matter, as in purulent ophthalmia.

The mere deposition of matter at the lower margin of the cornea, called onyx, is in general rapidly absorbed as the attendant inflammation is subdued; but central abscess is dispersed more slowly, and is apt to leave considerable opacity behind. Such a result, however, is favourable, compared to another termination which often takes place, viz. ulceration of the cornea over the abscess, and the discharge of its contents leaving a deep ulcer. The abscess also sometimes opens into the anterior chamber, and the matter evacuated falling to the bottom of this, forms what is called *false hypopyon*. As regards the abscess itself, no interference is admissible. The only indication is to subdue the inflammation which has produced it as quickly as possible, and then nature will do more for the removal of it than any thing we can. As one means of giving a sudden check to the inflammation, evacuation of the aqueous humour is very useful. When the cornea has become infiltrated, ulceration takes place at the circumference, and the whole substance is gradually separated and thrown off in sloughs. The inevitable result is staphyloma of the iris.

Ulcers of the Cornea.

Ulceration of the cornea is a result of various inflammations of the eye. It may be limited to the conjunctival layer, or it may affect the proper substance also. The membrane of Descemet does not appear to be liable to ulceration, but, when exposed and deprived of support by ulceration of the proper substance of the cornea, bursts.

Superficial Ulcer of the Cornea.—This resembles a mere abrasion, the ulcerative absorption being limited to the epidermic part of the conjunctiva corneæ. It has a great tendency to spread, and while it spreads on one side, cicatrization takes place on another. Increased vascularity of the cornea is very frequently combined with superficial ulceration, especially when it is an accompaniment of granular conjunctiva. In such cases it is the upper part of the cornea which is the principal seat of the disease.

Semi-opacity only results from the cicatrization of this ulcer.

Deep Ulcer of the Cornea.—Circumscribed deep ulcer of the cornea most generally results from the bursting of an abscess of the cornea, or a phlyctenula or an aphthous pustule.

The characters of such an ulcer depend entirely on the kind and degree of inflammation present. The ulcer may be both deep and large, with ragged and everted edges; its bottom filled with a grayish, sloughy-looking matter, which is thrown off to be succeeded by the same thing, whilst the ulcer goes on increasing in depth. On close inspection, single red vessels may be seen coursing towards the part from different directions. In another case, the ulcer, neither so large perhaps nor so foul and flocculent-looking, is the point of termination of a fasciculus of enlarged corneo-conjunctival vessels. The cornea for some distance around an ulcer is usually more or less nebulous. But when the ulcer begins to heal, its edges become decidedly gray and opaque. Where there is a fasciculus of vessels, one after another shrinks and disappears, and their track remains for some time marked by a nebulous streak. According to the extent and depth of the ulcer, so is the extent and degree of the opacity of the cicatrice. The opacity does not entirely disperse, though it has a tendency to become more and more circumscribed as the mere lymphatic effusion, which had taken place in the adjacent sound part of the cornea, is removed by absorption.

There is a circumscribed and sometimes rather deep ulcer of the cornea, met with especially in weak states of constitution, which is circular, with smooth round edges, quite clear even to its bottom, and the cornea around scarcely, if at all, nebulous. The cornea looks simply as if a small piece of it had been scooped out. After this ulcer has healed a clear facet remains.

Destructive ulceration of the cornea, without much or any appearance of inflammation of the eye, is sometimes observed in cases of great exhaustion of the system from whatever cause, and also in cases of disease of the fifth pair.

In cases of purulent ophthalmia, attended with chemosis, though abscess and destruction of the cornea may not have taken place, the cornea is sometimes found, after the chemosis subsides, ulcerated exactly at the place where the chemosed conjunctiva had pressed. The ulceration presents itself, therefore, in the form of a more or less deep groove, concentric with, but a little within, the margin of the cornea, and extending round it to a greater or less extent.

Sometimes the whole surface of an ulcer of the cornea is found covered with a matter resembling (to use the comparison of Mr. Wardrop) wet chalk. This appearance is attributed by Dr. Jacob to a precipitate from the acetate of lead solution so frequently employed as an eye-water. Beer had already remarked that the use of lead lotions rendered the cornea opaque. Any part of the conjunctiva, if abraded, may be the seat of the deposit, but attention is most usually drawn to it when on the cornea. The white deposit is apt to become fixed in the cicatrice, which is then dense and indelible. Dr. Jacob[1] says, that the opacity appears to be produced at once by a single application. He has seen it the day after a drop of solution of acetate of lead had been put into the eye by mistake. A white deposit does not take place in all cases in which the acetate of lead is used; but Dr. Jacob says he does not think he can state positively the precise condition of the ulcer which causes it.

Dr. Mackenzie recommends a cautious attempt to be made to remove, with a small silver spatula, the white deposit from the surface of the ulcer; and he tells us that in one case he succeeded in separating a scale of lead which had been deposited on the cornea[2].

An ulcer on the internal surface of the cornea appears to be the result of the bursting of an abscess of the cornea into the anterior chamber. There is, therefore, at the same time, false hypopyon, and the cornea at the affected place is dim, and has a tendency to become prominent.

The *treatment* comes under the head of that of the ophthalmia which has given rise to the ulceration of the cornea; but such details as the following may be mentioned here:—

As chronic superficial spreading ulceration of the cornea is frequently accompanied by a granulated state of the palpebral conjunctiva, this source of irritation requires to be particularly looked to.

When a deep ulcer is threatening to penetrate, the evacuation of the aqueous humour often proves of great service by taking off the strain from the ulcerated part, and the inflammatory action usually receiving at the same time at least a momentary check, the conditions are favourable for the operation of remedies and the establishment of granulation.

When an ulcer of the cornea near the centre threatens to penetrate, it is advisable to keep the pupil constantly under the influence of belladonna, in order that, should perforation and consequent escape of the aqueous humour take place, prolapse of the iris may not follow.

Hernia of the membrane of the aqueous humour (Keratocele).

When an ulcer has penetrated through the proper substance of the cornea, its inward progress is arrested by the membrane of Descemet, which, unable to withstand the pressure from within, is protruded at the bottom of the ulcer, in the form of a small vesicle filled with aqueous humour. This hernia of the membrane of the aqueous humour usually bursts ere long; the aqueous humour is thus allowed to escape, whereupon the iris falls forward into contact with the cornea, and the tension of the eye is diminished. If now a remission of the attending inflammation results, the ulcerated opening in the cornea becomes filled up, the aqueous humour again accumulates, and the iris returns to its natural position, provided no prolapse of it has taken place.

In some cases when ulceration of the cornea is both broad and deep, but not penetrating entirely through the proper substance, the hernia of the membrane of the aqueous humour which takes place is large, and still invested with some of the corneal substance. In consequence of this it does not readily burst, but may remain permanent as a thinned and projecting part of the cornea with impaired transparency, resembling somewhat conical cornea, from which, however, it is to be distinguished. From partial staphyloma it differs in not being connected with the iris, and never being so opaque.

By the bursting of an onyx into the anterior chamber, the membrane of Descemet and the inner part of the corneal substance is destroyed; the outer part then, incapable of withstanding the pressure from within, sometimes yields and forms a prominence of a conical shape.

Prolapsus Iridis.

Prolapse of the iris, in consequence of a penetrating wound of the cornea, has been already noticed. When it occurs in consequence of the cornea being penetrated by ulceration, there is much less likelihood of restoring it to its place, but much may be done to prevent its prolapse, by keeping the pupil under the influence of belladonna, when an ulcer near the centre of the cornea is threatening to penetrate.

According to the size and position of the ulcerated opening in the cornea, so is the extent of the prolapse of the iris, and so is the pupil more or less involved. The different degrees of prolapsus iridis have received different names; thus, when small it is called *myocephalon*, from its forming a small black point like the head of a fly;—when it is a little larger and flattened down by the pressure of the eyelids it has been compared to the head of a nail, whence the name *clavus*. When larger and more prominent, it has been called *melon* or apple-shaped prolapse. When the iris is protruded at several openings, the appearance is somewhat like a bunch of grapes, whence the name *staphyloma racemosum*. When prolapsus iridis has taken place, all the symptoms of the attending inflammation are apt to be aggravated. But if the inflammation subsides, and if the prolapse of the iris be within certain limits, it gradually contracts and flattens as the ulcer of the cornea closes, and nothing at last remains but the cicatrice in the cornea and synechia anterior, with more or less deformed and contracted pupil. If the prolapse of the iris have exceeded the limits alluded to, it never collapses, but, as will be immediately seen, lays the ground for the formation of astaphyloma of the cornea and iris, partial or complete.

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[1] Dublin Hospital Reports, vol. v. p. 370.

[2] Mr. Tyrrell, in his recently published work, describes a particular disease of the cornea under the name of "Inflammation of the Cornea with deposition of earthy matter," and this he thinks is the same as the, according to him, alleged accidental deposition on ulcers of the cornea, from lead lotions above described. Without denying that an insoluble precipitate may adhere to an ulcerated surface, Mr. Tyrrell considers that in all the cases which have come under his notice, the deposition had not this origin.

Treatment.—The less that is done to the protrusion of the iris the better. The attention ought to be directed to the removal of the inflammation, of which the protrusion of the iris is a remote consequence.

Staphyloma of the Cornea and Iris.

An opacity, and unnatural prominence of a part or of the whole of the cornea of a grayish white, or mother of pearl, colour.

Such is the definition which a first view would suggest of *partial* or *total spherical staphyloma* of the cornea and iris ; that it is not quite accurate, however, will be shown when the nature of the morbid change comes under consideration.

Partial Staphyloma.

Objective Symptoms[1].—This is usually situated about the lower or lateral part of the cornea, and may vary in extent from a quarter to a full half of the area of that membrane. On close examination, the iris is seen drawn towards and joined to the whole inner surface of the opaque projection. The anterior chamber is in consequence much contracted. According to the situation and extent of the staphyloma, so is the pupil more or less involved ;—and that either by direct incorporation of the pupillary margin of the iris, or by opacity extending to the part of the cornea over the pupil.

Subjective symptoms.—Vision is impaired in proportion. Besides this, the prominence being on the one hand exposed to the desiccant and irritating action of the air, &c., and on the other, acting as a foreign body, frequent nictitation is excited, which serves but to irritate both the staphyloma and eyelids ;—whence the weak state of the eye and frequent attacks of inflammation.

Total spherical Staphyloma.

Objective Symptoms [2].—In this case there is no longer any remains of transparent cornea ; but its place is occupied by the opaque structure, which forms a prominence so large as to stretch and press out the eyelids, or even to project considerably from between them.

Subjective Symptoms.—Vision is totally gone ; but a perception of light and shade, &c., may remain.

Course.—The staphyloma may remain stationary, but sometimes it goes on increasing in size till it bursts. This is attended with very severe symptoms, such as distention in the eye, circumorbital pain, preventing sleep and exhausting the patient. On the bursting of the eye, these symptoms immediately subside, and if together with aqueous humour the lens and part of the vitreous humour have escaped, the eye does not again become distended, but contracts into a stump, marked with depressions at the places corresponding to the insertion of the straight muscles. If all the vitreous humour has escaped, the membranes shrink back in the orbit, and form a small shapeless mass at its bottom.

If the aqueous humour only escapes, the staphyloma sinks for a day or two, but soon returns to its former state, when by the closure of the laceration, the aqueous humour is allowed to reaccumulate.

Pathology.—In consequence of inflammation, the structure of the cornea is changed, the iris adheres surface to surface, and the two together are distended into a more or less extensive opaque prominence. Such, in a few words, was the commonly received opinion regarding the formation of staphyloma of the cornea and iris up to the time I enunciated a different view of the matter [1].

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[1] Figure 5.

[2] Figure 6.

[1] London Medical Gazette, vol. xxi. p. 847. London 1838. It may not be irrelevant to mention that Mr. Tyrrell, in his work recently published (vol. i. p. 270), gives essentially the same view.

In the new edition of his valuable " Treatise on the Diseases of the Eye," just published, Mr. Lawrence devotes a considerable space to a critique of my views regarding the pathology of staphyloma. Whatever Mr. Lawrence writes is sure to carry great weight with it. It is for this reason I think it necessary to examine into the validity of his objections.

Mr. Lawrence says, p. 363, " Mr. Jones finds it difficult to understand how the iris can become adherent to the cornea ; yet partial synechia anterior occurs, not unfrequently, without wound or penetrating ulcer, as an effect of acute corneitis, and in conjunction with leucoma." In answer to this it is to be remarked, that to *understand* how the iris can become adherent to the cornea, without wound or penetrating ulcer, is not the question : but the question is, " Is it the *fact* that the iris does become adherent to the cornea under the circumstances named?" In reply to this question, I have only to repeat, that I never saw any direct adhesion between the cornea and iris, partial or complete, take place in inflammation of the cornea, of the membrane of the aqueous humour, of the iris, &c. Mr. Lawrence asserts the contrary, but adduces no facts in support of his affirmation. With whom lies the *onus probandi?*

Synechia anterior, in conjunction with leucoma, I have often seen ; and it is in strict conformity with my views : for if the previous history of such a case be examined, penetrating ulceration of the cornea, escape of the aqueous humour, falling forward of the iris, implication of a small part of it in the ulcerated opening of the cornea, and the subsequent incorporation of it in the cicatrice, will be found to have occurred.

Mr. Lawrence further objects :—" He (Mr. Jones) enumerates various cases of disease, wound, and operations, involving the cornea, in which no adhesion of the iris takes place. We cannot hence infer, that the iris will not become adherent to the cornea in the widely different morbid conditions of the organ which lead to the development of staphyloma." The following quotation from the paper Mr. L. is criticising, is a ready-made answer to this :—" But it may be said, it is not in consequence of such inflammations of the eye that staphyloma occurs, but that 'purulent, gonorrhœal, and variolous ophthalmiæ are the most frequent causes of staphyloma' (quotation from Mr. Lawrence's own work, 1st ed. p. 374). True ; but under what conditions does staphyloma occur in those diseases? Not by

If in scrophulous, catarrhal, or catarrho-rheumatic ophthalmia, there be a penetrating ulcer of the cornea, the aqueous humour, as has been already mentioned, escapes, the iris falls forward into contact with the cornea, and a small part of it is perhaps prolapsed through the ulcerated opening. The progress of the ulceration being stopped by the yielding of the inflammation, the prolapsed portion of the iris, and the ulcerated part of the cornea are involved in one cicatrice. The opening in the cornea being thus closed, the aqueous humour again collects, and the anterior chamber is restored; though somewhat diminished, in consequence of the partial adhesion between the iris and cornea (*synechia anterior*). There is no prominent distention on the front of the eye in this case, because, as the inflammation subsides, the small protruded portion of iris shrinks and flattens; but if the destruction of the cornea has gone on farther, either by extension of ulceration from a continuance of the inflammation, or by the giving way of an abscess of the cornea, and considerably more of the iris has protruded, the prolapsed portion of the iris does not shrink when the inflammation begins to abate, as in the former case, but remains, and forms a projection at the part of the cornea implicated, which is generally the lower or lateral. This projection is at first merely a bag of the iris distended by the aqueous humour, and is called *staphyloma iridis;* but, by and by, its exposed surface becomes covered by an opaque firm tissue, of the nature of the *tissue of cicatrice*, and this tissue is incorporated at the base of the tumour with the sound cornea. The projection, the mode of origin of which I have just described, is a *partial staphyloma;* it is not a distention of the cornea itself, but a protruded portion of the iris covered by a *new tissue*, intended to supply the loss of substance which the cornea has sustained. The mode of origin of a *total staphyloma* is essentially the same, but differs only in degree. The whole or greater part of the cornea being destroyed, as occurs in gonorrhœal, purulent, and very often in variolous ophthalmia, as also that of new-born infants, the whole iris falls forward, the pupil becomes closed, and the aqueous humour, being thus allowed to accumulate in the posterior chamber, the iris is kept distended in the form of a tumour on the front of the eye. Its surface gradually gets covered with an opaque cicatrice-like tissue, or pseudo-cornea, which assumes a greater or less degree of thickness, and a total staphyloma is the result. Sometimes

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adhesion of the iris to the cornea, surface to surface. . . . . Purulent, gonorrhœal, and variolous ophthalmiæ are the diseases of the eye in consequence of which staphyloma most frequently occurs, and these are the very diseases in which the cornea is more or less extensively destroyed."

Again, Mr. Lawrence:—" Mr. Jones has forgotten to explain how, when the whole cornea has been destroyed, the aqueous humour can be accumulated in the posterior chamber, so as to distend the iris into a staphylomatous tumour." The ready-made answer to this again is, " The whole or greater part of the cornea being destroyed, as occurs in gonorrhœal, purulent, and very often in variolous ophthalmiæ, as also that of new-born infants, the whole iris falls forward, *the pupil becomes closed*, and the aqueous humour being thus allowed to accumulate in the posterior chamber, the iris is kept distended in the form of a tumour on the front of the eye."—Op. et loc. cit. p. 849. This surely is no indication of forgetfulness on my part; but, when the reader is informed that the words just quoted actually occur in the extract from my paper which Mr. L. himself gives in the preceding page, he will be inclined to attribute forgetfulness rather to Mr. Lawrence.

Mr. Lawrence thinks it *probable* that the explanation offered by me is correct, as regards partial staphyloma; but, respecting total staphyloma, he thinks the old notion the correct one. " If it be otherwise," he adds, " and if Mr. Jones be right, we want proofs; his mere *assertion* is not sufficient." In my paper I have *asserted* nothing, but I have simply described the result of observation of many cases. And for proofs I refer to observation.

Mr. Lawrence gives the result of his observation as follows:—" What I have observed, after entire destruction of the cornea, is, that the bulging iris has gradually receded, and become covered by an opaque pellicle; the front of the eye being thus permanently flattened." I have also observed the same thing in some cases, and remark of them in my paper. " In those cases in which the eye is destroyed by purulent ophthalmia, whether in adults or new-born infants, by gonorrhœal ophthalmia, variolous ophthalmia, &c. and in which staphyloma does not form, but the eyeball shrinks, and becomes atrophic, I suspect (though, at present, I cannot adduce any direct proof) the lens has escaped on the giving way of the cornea."—Op. et loc. cit. p. 850.

As if unwilling wholly to depend on what he has himself observed, Mr. Lawrence admits, however, that it is " not improbable that the iris, instead of shrinking, may sometimes be pushed out by the secretion of aqueous humour in the posterior chamber, and form staphyloma." But then, he adds, as if to deprive me of the benefit of the admission, " This view of the subject, adopted, as I think, too exclusively by Mr. Jones, had been already clearly set forth, in explanation[?] of certain cases, by the late Mr. Ware, who says, ' I have sometimes seen the whole cornea sloughed off, during an acute purulent ophthalmia, and a white opaque substance gradually effused from the ulcerated surface, sufficient to form a complete cover to the iris; after which the opaque body has gradually projected in a conical shape, until at length it has become so prominent as to hinder the eyelids from closing over it.' " This excellent description by Mr. Ware refers exactly to the cases on which I founded my views regarding staphyloma; but Mr. Ware *infers* nothing from them in regard to the general pathology of staphyloma. Indeed his general notion of the subject appears to have been, that staphyloma was a diseased cornea, without participation of the iris, and that staphyloma, after sloughing of the cornea, was an extraordinary occurrence. The observation of a fact is one thing, and the inference therefrom deduced is another. Observations similar to those recorded by Mr. Ware, must have frequently been made by surgeons; but I have not yet found any author who has anticipated my views. Mr. L. indeed mentions, in the new edition of his work, among the generally received opinions respecting the mode in which staphyloma corneæ is produced, that the external surface of the staphylomatous swelling is formed of a tissue, like that of cicatrix, covering the iris where it has been denuded by sloughing of the cornea. But where, I would ask, does he find such a view stated, except in my paper? There are no such words in his former edition; and the interpolation is shown by this, that I am represented as questioning the very views I maintain, and for which Mr. L. takes so much trouble to criticise me.

the central part only of the cornea is destroyed, a ring of the circumference still remaining; the staphylomatous projection has then the form of a small globe stuck on the front of a larger, but if disease has extended to the ciliary body, the whole front of the eye is prominent like a blunt cone.

The pseudo-cornea, both in partial and in spherical staphyloma, is more or less pervaded by dark-coloured varicose vessels.

A circumstance in the pathological anatomy of staphyloma worthy of being noticed is, that when the tumour attains a large size, the iris, unable to expand to the same degree as the pseudo-cornea, and its texture much more frail, separates from the choroid and becomes torn into shreds; so that when we examine the internal surface of such a staphyloma, after death, or after it has been removed by operation, we find the iris, which adheres to the pseudo-cornea, broken and reticulated; whereas the internal surface of a staphyloma, which has not reached a great size, exhibits the iris still entire[1].

That the cornea and iris do not unite surface to surface, to form a staphyloma, may be inferred from what has been said above; but the following considerations show that such a union is not prone to take place under any circumstances.

In penetrating ulcer of the cornea, and prolapsus iridis, of course the prolapsed part of the iris adheres to the cornea at the one point. But though the two membranes have come into contact in the whole extent of their surfaces, in consequence of the escape of the aqueous humour through the opening in the cornea, made by the penetrating ulcer; and though, in consequence of the attending inflammation, the circumstances favourable for adhesion exist, still the iris does not adhere to the cornea, surface to surface, as the pleura pulmonalis does to the pleura costalis. On the contrary, as soon as the ulcerated opening in the cornea closes, so that the aqueous humour is allowed to accumulate, the iris recedes from the cornea, and the anterior chamber is re-established. The only adhesion between the iris and cornea is at the one point where the prolapsus iridis took place. Again, cases of penetrating ulcer of the cornea occur, in which the aqueous humour having escaped, and the iris come into contact with the cornea, but no prolapse of the former having taken place, no adhesion at all between the two ensues, but the iris recedes from the cornea as soon as the opening in it from the ulcer closes, and prevents the farther escape of aqueous humour. One would suppose that if adhesion between the anterior surface of the iris and inner surface of the cornea were a thing prone to take place, that it would have been observed in those cases of inflammation of the membrane of the aqueous humour in which the operation for evacuating the latter has been performed; but I apprehend no one ever saw such a result. In the operation for the extraction of the lens in cataract, the aqueous humour having escaped, the iris comes into contact with the cornea, and continues so for a considerable period: but if there be no prolapsus iridis adhesion never takes place. If the iris does not adhere to the cornea when these two parts come into contact, from the escape of the aqueous humour, and while in a state of inflammation, much less do they adhere, independently of the removal of that fluid.

But it may be said, it is not in consequence of such inflammations of the eye that staphyloma occurs, but that purulent, gonorrhœal, and variolous ophthalmia, are the most frequent causes of staphyloma? True; but under what conditions does staphyloma occur in those diseases? Not by adhesion of the iris to the cornea, surface to surface, but only when the cornea has been more or less extensively destroyed. Now purulent, gonorrhœal, and variolous ophthalmiæ are the very diseases in which, as is well-known, this takes place.

Diagnosis of partial Staphyloma.—Conical cornea can scarcely be confounded with partial staphyloma, but a form of hernia corneæ resembles it in being prominent, but differs from it in not being so opaque, and in not having the iris adhering to it. An albugo is opaque, but not so prominent as a partial staphyloma, and as in the preceding instance free of any adhesion with the iris. A leucoma is opaque and may be combined with synechia anterior, but the adhesion of the iris is comparatively of small extent, and the prominence of staphyloma is wanting.

Prognosis and treatment.—If the staphyloma be small and do not implicate the pupil much, the less that is done by way of treatment the better, but irritation is to be guarded against, and any tendency to inflammation kept down by occasionally dropping in a solution of nitrate of silver or diluted vinum opii. In a case in which the opposite eye is injured and vision lost, if the staphyloma implicate the pupil, it will be proper to attempt to diminish its projection in order to pave the way for the formation of an artificial pupil.

The *treatment* which has been adopted with this view consists in repeatedly touching the staphyloma with some caustic, such as chloride of antimony, nitrate of silver, or caustic potash, in order by a slow inflammatory process to produce condensation and contraction of it. The eschar of one cauterization should be allowed to fall off, and the other effects to subside before a repetition of the caustic. The best plan is, to commence touching the base of the staphyloma at points all round, and then gradually proceeding towards the apex. The above described treatment is assisted in effecting the consolidation and flattening of the pseudo-cornea by frequently evacuating the aqueous humour.

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[1] Beer's Ansicht der staphylomatösen Metamorphosen des Auges; Wien, 1805. Mackenzie's Practical Treatise, 3d edition, p. 572-3. London, 1840.

Mr. Tyrrell says he has succeeded, in several instances, in effecting a reduction of partial staphyloma, by the careful application of nitrate of silver, or hydrate of potash, in substance. He applies the escharotic first at the base of the projection, taking care not to injure the remaining sound cornea: the effect has been the separation of a small slough; but previous to such separation, a deposit of fibrine has taken place beneath, by which the deeper part has become more solid and strengthened. After the part has recovered from one application, he makes a second close to, but not upon the same spot, and nearer to the summit of the projection. Again and again he repeats this operation, acting upon the more prominent part, until a considerable or perfect reduction of the staphyloma has been accomplished; and this has enabled him, in a few cases, to form an artificial pupil, subsequently of much more utility to the patient. He prefers the hydrate of potash, unless the projection be very small; for its use is followed by a much larger deposit of fibrine than results from the nitrate of silver [1].

Prognosis and treatment of total Staphyloma.

When an inflammation of the eye has run so disastrous a course, that the conditions for the formation of a total staphyloma are laid, any treatment which may be adopted can have for its object, not to save the eye as an organ of vision, but to prevent it from degenerating into a tumour, which not only causes great deformity, but is a source of considerable irritation even to the opposite eye, so much so, that the patient seeks for its removal by operation, sooner or later.

Prophylactic treatment.—According to the account of the mode of formation of total staphyloma above given, it appears that the supply of aqueous humour in the still-existing posterior chamber, is what keeps up the distention of the iris, so that the pseudo-cornea which is moulded on its surface, presents the form of a round prominence on the front of the eye. If this be the case, the destruction of the source of the aqueous humour by breaking in upon the integrity of the posterior chamber, is the means which offers to prevent the development of the staphylomatous projection. The simplest plan of effecting this appearing to me to be the extraction of the lens, I put the operation into practice in the following case:—

A man, about twenty-two years old, came to me labouring under the effects of severe purulent ophthalmia of both eyes. In the right eye, the cornea being destroyed and the pupil closed, the iris protruded and was distended with aqueous humour. The left eye had also suffered very much; there was penetrating ulcer, prolapsus iridis, and consequently considerable distortion and contraction of the pupil. Both eyes were still affected with the inflammation, and it was very doubtful whether the left eye could be prevented from getting worse, especially as it was evidently kept in a state of additional irritation from the presence of the staphyloma in the right. By an incision with a Beer's cataract-knife through the protruding and distended iris, the lens was extracted. Severe re-action followed; less perhaps in consequence of the operation, than from the patient not being in a situation to take proper care of himself. The iris did not again become distended; on the contrary, the eye shrunk, and irritation being thus removed, the left eye progressively recovered, as far as the organic changes it had already undergone allowed, and further than there had been reason to hope for, as sufficient vision was preserved to enable the patient to resume his employment as a porter.

In those cases in which the eye is destroyed by purulent ophthalmia, whether in adults or new-born infants, by gonorrhœal ophthalmia, variolous ophthalmia, &c. and in which staphyloma does not result, but the cicatrice which forms in the place of the cornea is flat and the eyeball becomes atrophic, I suspect the lens has escaped on the giving way of the cornea.

A fully formed total spherical staphyloma is a source of great deformity: its removal therefore is often sought for in order that an artificial eye may be worn. But what principally demands its removal, sooner or later, is the irritation which it keeps up, and which is apt to be communicated to the opposite eye.

Operation for the removal of fully-formed total spherical Staphyloma.—Compression, ligature, seton, caustics, incision, variously modified or combined, have been recommended as a means of repressing staphyloma; but it is now agreed that the only proceeding to be depended on for the removal of the tumour, is its abscission. The excision of a piece of the size of a lentil, one of the methods recommended by Celsus, was adopted by Scarpa, under the impression that it was less liable to be followed by severe reaction than the abscission of the whole. It has, however been found that the latter is not usually followed by any dangerous accident, while the former does not always effect the desired object.

The patient is seated on a chair opposite a window, and leans his head on the breast of an assistant who stands behind, and who also supports the chin with the palm of one hand, whilst with the fingers he depresses the lower eyelid. With the fingers of the other hand he raises the upper eyelid. The surgeon then, having command of the eyeball by means of a large hook [1] passed through the staphyloma, or by means of a ligature previously introduced with a curved needle, proceeds in the following manner:—

With the staphyloma-knife [2] its edge being directed upwards, he transfixes the tumour at its base, from the temporal to the nasal side, and somewhat below its transverse diameter. Pushing the knife on, it cuts itself out, and a flap is formed, as in the operation for extracting the cataract. The flap thus made is seized with a forceps, and the remaining part of the base of the staphyloma divided with a curved scissors, and the whole removed.

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[1] A practical work on the Diseases of the Eye, &c. vol. i. p. 273. London, 1840.

[1] Figure 10.

[2] Figure 11.

After the operation, the eyelids of both eyes are to be kept closed by strips of court-plaster, and covered with a light compress and roller.

Under ordinary circumstances the wound is found, at the end of a week, closed by a semi-transparent membrane, which by and by becomes denser and more opaque. A flat cicatrice, marked with bluish or brownish streaks, remains. Sometimes a fungus grows from the wound, which, however, readily subsides after being occasionally touched with lunar caustic. Considerable pain attends the operation for staphyloma, and there is usually more or less hæmorrhage at the time ; and it occasionally happens that, some hours after, the eyeball becomes distended with blood, and the clots, or infiltrated vitreous body, protrude from the wound. The bloody, dark-coloured mass is to be cut away with scissors, and the eye covered with a compress soaked in cold water.

If severe reaction follows the operation, antiphlogistics, anodynes, and warm fomentations, &c. will be required.

Though the lens and even some of the vitreous humour escape, the remains of the eye form a good stump for the application of an artificial eye ; the lens often escapes, and it appears to me that it might always be removed with advantage. After the loss of much or all of the vitreous humour, the eyeball contracts to a very small size, and does not afford a proper support for an artificial eye.

Conical Staphyloma Corneæ.

This is a rare affection ; I have seen but one case agreeing with the descriptions given of it. It was in the left eye[1] of a scrofulous girl, whose right eye[2] was the seat of a very large partial staphyloma.

Symptoms.—In the eye affected with the conical staphyloma vision was quite gone. The cornea was enlarged at its circumference, and projected in the form of a pretty regular cone. The sclerotica was distended at its junction with the cornea, and partook of the conical transformation, so that the posterior half of the eyeball formed the basis of the cone of which the apex occupied the middle of the cornea. The eyeball was hard to the touch.

At their junction the sclerotica and cornea were of a dark blueish colour. At the apex of the cone the cornea was grayish white, and in the intermediate part it was brownish red, but still retaining some traces of its former transparency, though not sufficient to allow of the state of the interior of the eyeball being ascertained. The eye had a dirty appearance, and its front was pervaded by varicose vessels.

Diagnosis and Pathology.—Conical is quite different from spherical staphyloma corneæ, not only in shape but also in nature. In conical staphyloma, it is really the cornea that is degenerated and projected in a conical form. It is to be remarked, however, that this morbid change in the cornea is merely a part of a disease, involving not only the anterior half of the eyeball, but also the posterior half; whereas, in spherical staphyloma the latter is ordinarily sound. The morbid anatomy of conical staphyloma is not yet well determined.

Cause.—Conical staphyloma is the result of a slow inflammation of the whole eye in an unhealthy constitution.

Prognosis and treatment.—Conical staphyloma has not the same tendency to enlarge as spherical staphyloma. The disease is for the most part better let alone than interfered with.

Suffusion, Opacities, and Specks of the Cornea.

Congenital Opacity.—In the fœtus the cornea is opaque, but becomes clear towards the period of birth. Cases are occasionally met with in which this fœtal character of the cornea persists after birth ; generally however, if not always, in combination with dropsy of the aqueous chambers. In a few instances, the cornea has been found gradually to acquire its natural transparency, and vision, though myopic, to be obtained. Mr. Ware[1] relates several such cases, three of which occurred in one family. In two of the children the opacity was quite removed in less than a year ; in the third the transparency was not complete until the end of the second year. The corneæ remained very prominent, and the vision myopic. In another case both corneæ were large, prominent, and completely opaque at birth. At the end of nearly three years, the left cornea had become clear enough to allow the perception of large objects ; the opacity of the right cornea, though diminished round the circumference, remained at the centre so as to obscure the greater part of the pupil. In a fifth case, similar to the preceding, improvement had, at the end of a year, proceeded so far in one eye that the circumference of the cornea was quite transparent, and the opacity so far diminished in the centre, that the pupil could be seen. Improvement was less advanced in the other eye. It is worthy of remark, that in these cases, the clearing of the cornea proceeded from the circumference towards the centre, a course similar to what is observed in acquired opacity of the cornea.

Arcus Senilis, or *Gerontoxon.*—This is an annular opacity of the cornea within its circumference, which occurs in advanced periods of life, though it is sometimes observed below middle age.

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[1] Figure 7.

[2] Figure 5.

[1] Observations on the Treatment of the Epiphora, &c. p. 285. London, 1818. See also Lawrence's Treatise, 2d ed. p. 361.

The opacity is about the twentieth or thirtieth of an inch broad, and has an equal breadth of nearly clear cornea intervening between it and the circumference of the cornea.

Arcus senilis appears first at the upper and lower parts of the cornea, and by and by extends all round, though this does not always happen.

It is unimportant in a practical point of view, never being so extensive as to obstruct vision, and forming no counter-indication to any operation.

Arcus senilis must not be confounded with the blueish white ring round the extreme margin of the cornea, seen in some cases of internal inflammation, particularly in old persons.

Suffusion of the Cornea from distention.—A certain degree of tension is a necessary condition for the transparency and brilliancy of the cornea, as may be inferred from the dull appearance which the eye presents when the tone of the whole body is reduced by debilitating disease. Increased tension within certain limits adds to the brilliancy of the eye, as is seen in states of mental excitement, but beyond these limits of tension the cornea becomes suffused. This takes place more or less in all inflammations of the eye, in consequence either of increased distention from within, or pressure from without.

That dimness or brilliancy of the cornea, in the degree referred to, is dependent on its state of tension, is well illustrated by what may be observed in the eye of an animal recently slaughtered. Thus, if a sheep's eye be removed from the orbit, and slightly compressed by grasping it in the hand, the cornea, which was before relaxed and dull, becomes distended and clear, but if the eye be more tightly grasped the cornea is rendered more tense, but at the same time is suffused with a milky opacity. This, however, disappears on relaxing the pressure. The circumstance just related, first noticed by the late Dr. Barclay, of Edinburgh, led Mr. Wardrop to recognise the suffusion of the cornea, in certain cases of inflammation, as a sign of over-distention of it from increased accumulation of the aqueous humour, and to adopt the evacuation of the latter in order to relieve the distention of the eyeball,—the cause at once of considerable distress and of a continuance of the inflammatory action. The practice proved advantageous in many cases, but having been too often indiscriminately employed, the aggregate results have been unfavourable, or at least indifferent.

Opacity of the cornea is a frequent consequence of inflammation involving the structure primarily or secondarily, and is owing either to interstitial deposition, or to the cicatrization of an ulcer. The opacity occurs in various degrees of density, extent, and permanency, from a mere speck which tends ultimately to disappear, to a dense and indelible opacity, involving perhaps the whole centre of the cornea, and concealing the pupil.

Opacity from interstitial deposition.—The speck called *nebula* is semitransparent, and so shaded off at its circumference, that it presents no precise limits. An *albugo* is also shaded off at its circumference, but its centre is densely opaque, and slightly elevated; both of which characters are owing to the larger quantity of deposited lymph than in the simple nebula. A nebula is usually the result of an increased action of the vessels of the part, but not ending in the formation of a phlyctenula or pustule; albugo again is the result of a similar action which has terminated in the formation of a phlyctenula or pustule, but which phlyctenula or pustule has receded without being matured.

Sometimes an enlarged blood-vessel is seen running into an albugo, and very generally there may be observed, both in cases of albugo and opaque cicatrice, nebulous streaks extending from them towards the circumference of the cornea, indicating where enlarged blood-vessels had run.

Treatment of Opacity from interstitial deposition.—In proportion as the inflammation subsides, the opacity diminishes; therefore no special remedy is required for the opacity in the first place, and in the second, it is proper to wait, and see what the natural absorbent powers of the part can effect, which, especially in young persons, is often a great deal. If after this the opacity continues, and if it is so situated as to disturb vision, then we may try what local stimulants, counter-irritation, and especially tonics and change of air can do. The local stimulants which I have found most useful are the drops of a solution of corrosive sublimate with vinum opii, and the red precipitate salve. See article Collyrium.

Opacity from a cicatrice.—According as the ulcer of the cornea has involved merely the conjunctival layer, or both this and the proper substance, so is the cicatrice semitransparent or perfectly white. The circumference of an opacity from a cicatrice, is usually more defined than that of opacity from deposition. As connected with this subject it may be mentioned that Professor Chelius tells us he has several times found in gouty persons stony deposits in old cicatrices of the cornea (leucomata); and that Mr. Wardrop once met with several gritty particles and inequalities on the inner surface of the cornea.

Though after the healing of some ulcers of the cornea no opacity takes place, still, when the cicatrice of an ulcer is opaque, it is indelibly so, unless the ulcer has been a mere abrasion of the conjunctiva corneæ.

When an indelible opacity lies over the pupil, dilatation of this, kept up by the habitual use of a solution of belladonna extract dropped into the eye, is a very valuable resource[1]; and in cases in which the opacity

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[1] Figures 3 and 4.

occupies too much of the centre of the cornea for the dilatation of the pupil to be of any use, recourse must be had to an operation, so as either to prolapse a portion of the iris through a small incision at the margin of the cornea, and thus to draw the pupil opposite the clear part *(dislocation of the pupil,)* or to cut out a piece of the iris opposite the clear part of the cornea *(artificial pupil by excision)*.

Dimness of the inner surface of the Cornea.—The membrane of Descemet, when inflamed, is the seat of more or less milky suffusion, interspersed with numerous small opaque dots of an altogether peculiar appearance. When the membrane of Descemet, Dr. Jacob informs us, has been touched by the point of the needle in breaking up a cataract, an opacity is produced, closely resembling capsular cataract. I once observed a uniform but very slight suffusion of the membrane of Descemet produced in a woman, from whose eye I extracted a lenticular cataract, in consequence of her having, after the upper section of the cornea, suddenly turned up the eye, in which movement the flap, being caught by the upper eyelid, was folded down and the membrane of Descemet consequently grazed by the edge of the lid. Notwithstanding that this occurred twice during the operation, recovery, without any other untoward circumstance than the slight suffusion of the membrane of Descemet above mentioned, rapidly took place.

Tumours and excrescences of the cornea.—An extension of membrane like sclerotic conjunctiva over a part of the cornea, as is represented in figure 8, may be considered as an irregular and undue development or hypertrophy of the elementary chorion of the corneal conjunctiva. Growths, with hairs growing from them, analogous to those of the skin called *moles*, are sometimes met with, not only involving the sclerotic conjunctiva, but also the corneal. Warts also, or warty excrescences, have been found affecting the the corneal conjunctiva. Small fungous tumours sometimes sprout from an ulcerated part of the cornea. The treatment in all these cases is obvious.—See farther on this subject, articles Eye, Pannus, and Pterygium, The following case of fungous excrescence of the conjunctiva corneæ may be quoted here.

J. S. æt. forty, a strong, healthy-looking countryman, suffered for several years repeated attacks of ophthalmia. A pterygium subsequently formed on the nasal side of the right eye, and was for a long time treated with caustics ; but instead of diminishing under the treatment, it progressively increased in size and thickness, extending over the margin of the cornea, and at last implicating it so far as wholly to impede vision.

In July, 1837, the man came under the care of Dr. Rau in the following state :—A pale red fungous excrescence, with uneven granular surface, so perfectly covered the cornea that not a trace of it was to be discovered. The excrescence, which at the margins projected about a sixth of an inch above the surface of the sclerotica, was at its middle about one-half of an inch thick, so that it prevented the complete closure of the eyelids. It was insensible, firm, and consistent to the touch ; it appeared not very vascular, but was in connection, by means of dilated vessels, with a growth of the sclerotic conjunctiva, which appeared to proceed from, or at least to implicate, the semilunar fold. The rest of the sclerotic conjunctiva was injected. In the left eye there was a pterygium, which did not reach to the margin of the cornea.

Dr. Rau proceeded to the extirpation of the tumour with the knife, but with doubtful prognosis, as it was impossible to determine beforehand the state of the cornea. The mass, having the consistence of granular fat, gave way under the forceps, so that it was found impossible to separate it in an entire piece ; it was therefore removed in fragments, and even this was rendered difficult by the not inconsiderable hæmorrhage. After the removal of the excrescence, it became quite evident that it had its origin from the conjunctiva corneæ, the surface of which presented an uneven and granular appearance. A part of the large vessels of communication was excised. Notwithstanding repeated cauterization with lunar caustic, the tumour began to grow again, the vessels, of which a part had been excised, appeared as before, and in one month the fungus had again acquired a considerable size. Repeated extirpation of it and of a considerable fold of sclerotic conjunctiva, together with the much distended vessels, at last put a stop to the growth. Instead of the nitrate of silver, caustic potash was now employed. Besides being applied carefully to the whole surface, it was pencilled all round the cornea, so as to destroy the vascular communications. The remains quickly shrank and came away under the repeated application of vinum opii. A blueish smooth surface now came into view, and the patient had a distinct perception of light. The cornea, which was very vascular on the surface, gradually cleared under the use of nitrate of silver salve in alternation with vinum opii. In six weeks after this the pupil could be distinctly seen, and the clearing of the whole cornea ensued under the continued use of the nitrate of silver salve.

Two years after, Dr. Rau found the cornea of the right eye as transparent as that of the left, all trace of vascularity gone, and vision so good that the man had no difficulty in reading the finest print[1].

Mr. Travers gives an account of a somewhat similar case, in which the cornea was concealed by a lobulated tumour of a dark purple colour, and in which he extirpated the anterior hemisphere of the eyeball. On examination of the tumour, the cornea and sclerotica proved to be entire, and the morbid growth, lying upon and adhering to the cornea and a small portion

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[1] Fungöse Excrescenz der Conjunctiva Corneæ von Dr. Wilhelm Rau, Professor der Medicin in Bern. Ammon's Monatsschrift für Medicin, Augenheilkunde und Chirurgie. Vol. iii. p. 66. Leipzig, 1840.

FIG. 1.

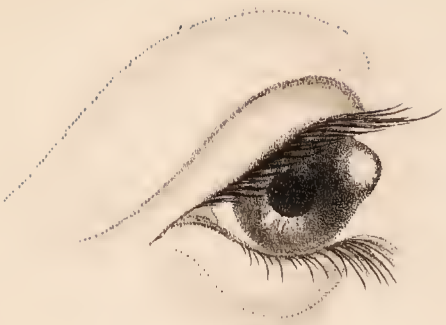


FIG. 2.

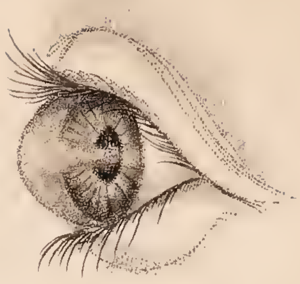


FIG. 3.

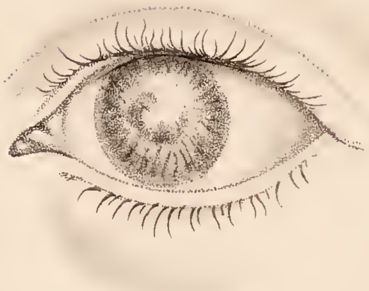


FIG. 4.

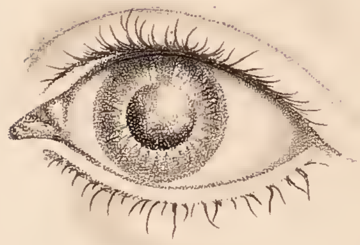


FIG. 5.

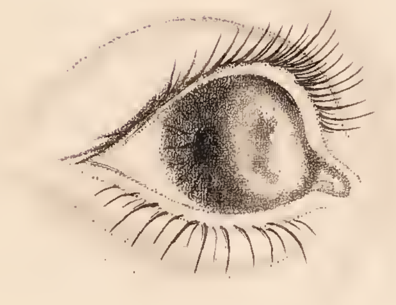


FIG. 6.

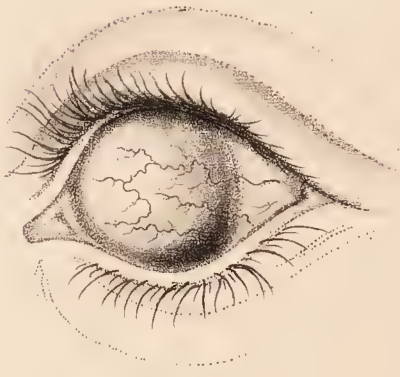


FIG. 7.

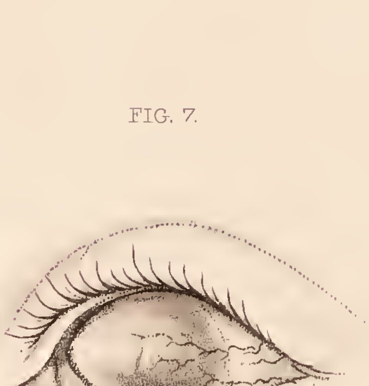
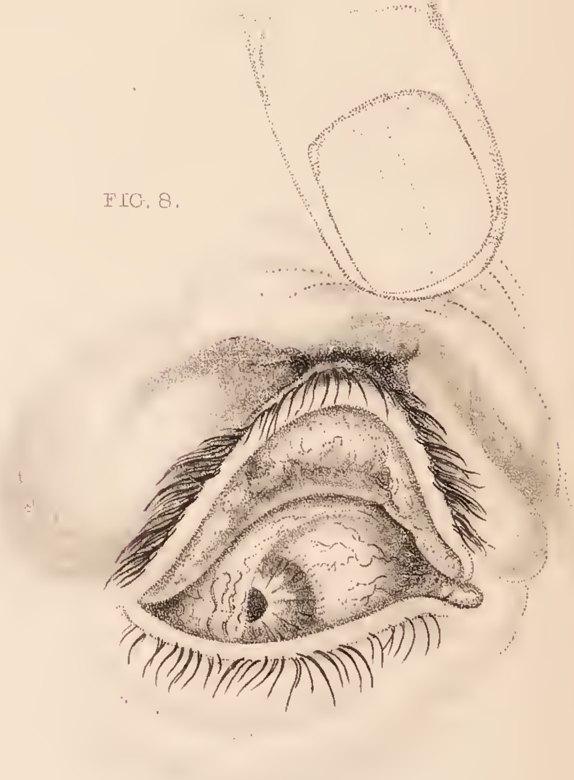


FIG. 8.



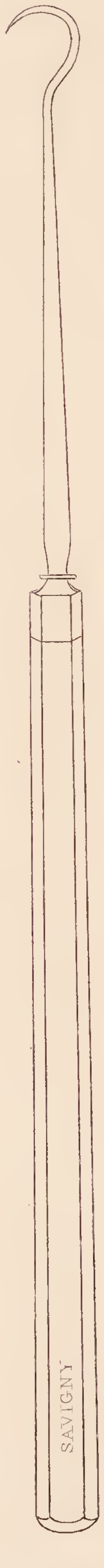


FIG. 10.

FIG. 11.

Alfred Adlard sculp

of the sclerotica, had acquired the lobulated appearance, as if by degeneration of the investing conjunctiva. The patient quickly recovered from the operation, and the remaining part of the eyeball collapsed.

Paracentesis of the Cornea.

The various objects for which this operation is had recourse to, are detailed in their proper places. Here the operation itself only falls to be described. It is simply the first step in making the section of the cornea for the extraction of a cataract. A cataract-knife or a lancet-shaped knife is the instrument best adapted for the purpose. If the operation is undertaken when the eye is much intolerant of light, there is great difficulty in exposing the cornea sufficiently for the purpose, as on the eyelids being opened, the eyeball is involuntarily rolled upwards. One eyelid requires to be secured by an assistant, while the surgeon takes charge of the other. The knife is entered at about one-tenth of an inch from the sclerotica, and in doing so, the principal precaution to be observed is not to push the point on in the substance of the cornea, under the impression that it has penetrated into the anterior chamber. The thickness of the cornea and the direction of its surfaces, are such as to require that the point of the instrument be at first directed towards the centre of the pupil. The point of the instrument having fairly pierced the cornea, its handle is to be inclined towards the temple before pushing the blade farther into the anterior chamber. The extent to which this is done, however, should never exceed the margin of the pupil, so that were the aqueous humour suddenly evacuated, the iris might be between the point of the instrument and the lens. Hence the propriety of using an instrument of the shape mentioned, which is calculated to make a sufficiently large puncture without penetrating far into the anterior chamber. The puncture having been sufficiently made, the instrument is to be withdrawn a little and slightly turned on its axis, so as to make the wound gape, and thus allow the aqueous humour readily to flow out. In proportion as this takes place, and the iris approaches the cornea, the knife is gradually withdrawn.

Description of the Plate.

Fig. 1. *Conical cornea.*
Fig. 2. *Spherical enlargement of the cornea, in consequence of corneitis.*
Fig. 3. *Central opacity of the cornea concealing the pupil.*
Fig. 4. *The same eye, with the pupil dilated by belladonna.*
Fig. 5. *Large partial staphyloma.*
Fig. 6. *Total spherical staphyloma.*
Fig. 7. *Conical staphyloma.*
Fig. 8. *Extension of membrane, like sclerotic conjunctiva, over a part of the cornea, in a case of ectropium from caries of the orbit.*
Fig. 9. *Silver spatula, for the removal of foreign bodies adhering to the cornea.*
Fig. 10. *Staphyloma hook.*
Fig. 11. *Staphyloma knife.*

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(*T. Wharton Jones.*)

CORNS, *clavus, spina pedis, gemursa*, Lat. *cor*, Fr. *Hühnerauge*, Ger.—A small, slightly elevated, hard tumour, produced by the long-continued, though remittent, pressure of tight shoes on the prominent parts of the feet or toes. Corns are developed in the cuticle, and are composed of layers of horny, demi-transparent tissue, in appearance inorganic. The hardened substance is hygrometrical, and is often the seat of pain or aching on the occurrence of change of weather, particularly in persons whose skin is delicate; it adheres but slightly to the surrounding epiderm, from which it may be detached by proceeding cautiously, either in the dry or wet state, although it seems firmly set by a root, which sometimes penetrates to the tendons and fibrous structures of the bones themselves. This root is organized, and contains blood-vessels. The pressure of the indurated epiderm is transmitted to the true skin beneath, which is thus bruised; and its blood-vessels, being proportionally developed, form a fine vascular network. Sir B. Brodie, who has carefully investigated this point of pathology, thinks that, to be completely formed, a corn must have a minute subcutaneous synovial bursa, analogous to those met with on bony or tendinous projections. This serous cyst, by attrition, is readily converted into a sanguineous ampulla.

According to situation, extent of induration, and degree of inflammation of the parts upon which a corn presses, will be the degree of suffering arising from it. In warm weather, the tenderness is greatest, and the progress of deposition of hardened substance most rapid. In extreme cases, exercise by walking is attended with great pain, and the individual hobbles rather than walks. The distress, however, is soon moderated by bathing, or rather, macerating the corn in warm water, paring off its prominent part, using loose slippers for a few days, and confining one's self to the horizontal position. Sometimes the small synovial bag becomes much distended, and even suppurates. This demands entire rest of the limb, and the prompt evacuation of the matter. Mere rest, however, and the rejection of tight shoes, often procures the dispersion of the horny projection, when not deeply rooted: of this we have examples in persons who are compelled, from accident or illness, to keep their beds for some time. Analogous results are obtained by relieving the corn of all pressure, by causing it to be borne by the surrounding skin; and this is done by superposing ten or a dozen pieces of linen, each with an aperture to receive the corn, so that, when a sufficient number are placed, the corn itself is protected from all pressure. This plan should be persevered in for some weeks. While in operation it may be assisted by rubbing the corn daily with the liniment of ammonia, using the warm pediluve at night, and, after drying the foot, scraping off with a blunt knife the thickened epiderm, thus reduced to a pulpy state. After the corn has been pared down or detached, and bathed, Mr. Wardrop recommends rubbing the exposed surface with nitrate of silver, or wetting it by means of a camel-hair pencil with an alcoholic solution of the hydrochlorate of mercury. The application is repeated till the cure is effected. Mr. Higginbotham's plan of using the nitrate of silver is somewhat similar. After its application, the part is left exposed till the nitrate dries. In ten days or a fortnight, when the surrounding cuticle begins to peel off, the foot is bathed in warm water, and the black crust, with as much of the corn as possible, is removed with a knife. The application is then renewed, as in Mr. Wardrop's plan.

The variety of corn-plasters recommended as heroic is immense,—a fact which only shows how difficult it is to eradicate an inveterate corn. As a sample, we give one which is favourably spoken of. It consists of two ounces of gum ammoniac, two ounces of yellow wax, and six drachms of acetate of copper. It must however be acknowledged, that the nature of this affection is not sufficiently understood; and that, whether it be treated by excision, or cauterization, or by both methods together, it is but too prone to return.

The induration, or callosity,—called by the French, *durillon*, or *oignon*,—produced by pressure on the heel, or on the edges of the foot, bears a strong affinity to corn. It is formed of successive layers of the epiderm, like those of an onion. It is observed commonly on the feet of great pedestrians, and on the hands of rowers, or others in whom particular parts of the skin are exposed to constant friction and pressure. The skin beneath, to which it is adherent, is swollen and injected; but no root is sent through it, as in the true corn. It is to be treated on the same principles as corn. A felt sole worn in the shoe, with a hole to correspond to the induration, is a common and a good remedy. The horny substance should be pared down, and filed with pumice-stone. Persons who perspire much in the feet are often plagued in warm weather by thickening of the epiderm in the angles of the toes. The skin, by constant maceration, is reduced to a whitish shrivelled and thickened pulp. It is easily removed by the use of the foot-bath; but, under the influence of the same causes, it soon reappears.

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Wm. B. Costello.

COUCHING, an operation for cataract.—See Cataract.

COUNTER-EXTENSION, from *Contra-extendere*, to extend in a contrary direction; *Gegenausdehnung*, Ger. Counter-extension is made in the coaptation of the fractured ends of bone, or in the reduction of a luxation, by fixing firmly the upper part of the limb, or the articular socket, whilst extension is made either by the hands or by instruments on the lower.

COUNTER-IRRITATION. Fr. *Révulsion;* Germ. *Gegenreiz.* This term is employed in therapeutics to denote an artificial irritation created on some part of the body for the purpose of abating or removing an irritation present in some other part more or less distant. The principle, deduced from the well-known fact, that if two pains exist simultaneously, but on different parts of the body, the stronger obscures the other, may be traced back to a very early period in the healing art. Nature indeed furnishes abundant examples in illustration, in what are called eruptive fevers, where the efflorescence on the skin serves to control the intensity of the internal disease.

This kind of medication is chiefly resorted to in inflammatory affections in the sub-acute or chronic stage, and in those of a neuralgic description; as also in promoting the absorption of effused fluids whether serous or purulent, and of other morbid products.

Counter-irritation may be effected by various agents, both physical and chemical, which possess the quality of exalting the local sensibility and capillary circulation; the result being manifested in simple rubefaction, in the development of vesicles, pimples, or pustules, or in the formation of an eschar. Accordingly, we find that mechanical friction, dry-cupping, irritant unguents, lotions and baths, blisters, moxas, caustics, and cauteries may be each ranked in this class of remedial agents.

In the majority of chronic cases where counter-irritation is indicated, it may be produced near the diseased part; thus in scrofulous caries of the joints upon the side of the articulation, in neuralgic pains and partial paralysis along the course of the affected nerve, in tetanus along the tract of the spine, and in certain spasmodic conditions affecting the neck of the bladder, over the hypogastric or perineal regions.

Counter-irritation of the skin, or subjacent cellular texture at the nape of the neck, has been found very efficacious against various disorders of the eyes; and cauterization upon the mastoid region has been strongly recommended in the instance of scrofulous ophthalmia. Mons. Gondret has collected several cases to attest the virtues of "sincipital cauterization," by means of an ammoniacal pommade, in certain forms of amaurosis and in incipient cataract. The practice of employing suppuratives to procure, what has been termed, "a remote centre of fluxion," has been often had recourse to after surgical operations, and sometimes, it is said, with advantage, especially in subjects of a gouty habit.

As a general rule, violent counter-irritation is improper when there is much local heat, pain on pressure, and febrile disturbance; as likewise in all situations where the integuments are thin and placed directly over bone, or where the circulation is languid, from the risk of giving rise to tedious ulceration or gangrene.

The pharmaceutical counter-irritants commonly resorted to, are the preparations of cantharides, mustard, mezereon, iodine, Tartar emetic ointment, oil of croton, oil of turpentine, strong acetic acid, and caustic ammonia. For further details connected with this subject, the reader is referred to the respective articles—Blistering, Caustics, Cauterization, Issue, Moxa, and Seton.

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COUNTER-OPENING, (*Contra-incisio,*) An incision made at a dependent part, to promote the exit of pus or a foreign body, when the opening, or wound already existing, is not favourably situated for the purpose.

COUVRE-CHEF, the name of a Bandage. See that Article.

COXALGIA, a name applied to disease of the hip-joint. Like the term *White-Swelling*, it should be entirely rejected, as too vague and indefinite for practical use.

CREPITUS, (*crepitatio*, Lat. from *crepitare; cliquetis*, Fr.; *Knirschen*, Ger.) The crackling or noise produced by the rubbing of the fractured ends of bone against each other. A crackling noise, designated by the same term, may be also recognized in cases of gangrene, or in emphysema, and is produced by the air developed or effused into the cellular membrane.

CROTCHET. Syn. *crotchet*, Fr.; *uncus, hamus*, Lat.; *Haken*, Ger. An instrument, with a shank strait or curved, and a hooked extremity; used to extract the head of the fœtus, after its perforation.

It is a very ancient instrument; for Hippocrates, after recommending warm baths and anointing the pudenda with warm oils, in cases where the head of the child was retained above the brim of the pelvis; says, if such means fail, the head is to be opened with a knife, and extracted by means of certain instruments: "Caput gladiolo dissectum, instrumento quod confringat comminuito, et ossicula per ossium *volsellam* extrahito, aut *unco* attractorio ad claviculam uti firmiter adhæreat immisso, non confestim, sed paulatim remittendo, et rursus adurgendo extrahito [1]." Celsus, in the twenty-ninth chapter of his seventh-book, speaks of it as a means of extracting a dead child. Ætius, in his twenty-third chapter, describes the method of lessening and extracting the child. Albucasis, in his Methodus Medendi, describes two species of forceps armed with teeth on the insides of the blades, by means of which the head may be pressed and crushed; and two species of crotchets. Other varieties of the crotchet were described by Fabricius d'Aquapendente, and indeed, by most of the older authors who discuss obstetrical subjects. Several of their instruments are found figured in the Armamentarium Chirurgicum of Scultetus. But it is evident that there were many imperfections in the instruments of the ancients, their object apparently being more to make an opening, into which some kind of hook could be fixed, than with any definite idea of lessening the bulk of the head. Thus, this operation, which in the majority of cases in the present day is one of little difficulty, was sometimes so encompassed by obstacles, that even Mauriceau had been unable to complete an operation he had commenced.

The French writers describe crotchets as being blunt or sharp; but in this country, the term crotchet is never understood to imply the blunt hook, it always being applied to the sharp instrument. The ancient crotchets were mere bars of iron bent at one end, the hooked extremity being sharpened. A wooden handle was afterwards added. Levret was the first to curve the stem, an improvement by which so much power was gained, that it is now almost universally adopted. Levret also recommended two blades, one for each side of the head; but as the application of such an

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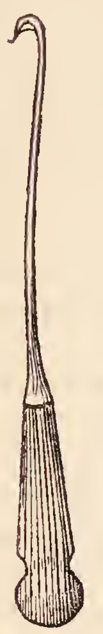
[1] De morbis mulierum; lib. 1. sect. v.

Fig. 186.



instrument is never necessary, and seldom practicable, it has become obsolete. The annexed sketch exhibits that now in most common use.

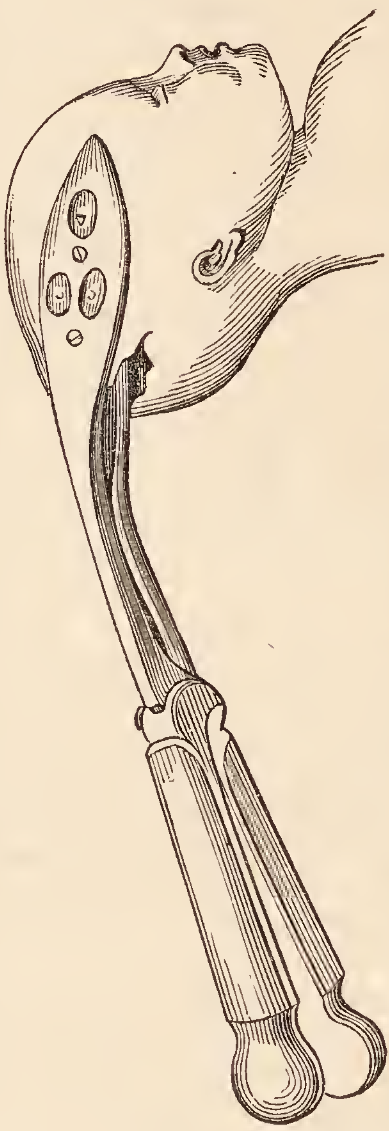
It is a very simple instrument, but one which can seldom be obtained of a proper temper. It must neither bend, nor break : be neither too sharp, to tear through the bone so as to injure the structure of the mother, or the finger of the attendant ; nor so blunt that it will not afford a firm purchase.

Mode of application.—We shall suppose then, that the head of the child has been opened, and both cerebrum and cerebellum thoroughly broken up ; (a point of great importance, as cases are recorded of children screaming loudly on birth, after the head had been opened, and the brain only partly extracted ; a circumstance necessarily most horrifying to all parties concerned :) and it is considered, that even in the diminished state of the head, the powers of nature are insufficient to complete delivery. Extraction then must be commenced, and if the crotchet is the instrument selected, it is to be introduced within the cranium, and fixed in some part of the bone likely to support firm traction. The instrument is held in and directed by the right hand, a finger of the left being placed on the external surface of the head, exactly opposite the spot on which the point of the crotchet is fixed, in order that if the bone give way, the structure of the mother may be protected from injury. A steady extracting force, commencing gently, and gradually increasing it, must be applied in the direction of the axis of the pelvic inlet, that is in a line from the umbilicus to the lower part of the sacrum. If the disproportion between the bulk of the fœtal skull and the size of the pelvis be not very great, we shall find the head gradually descend ; and probably after having passed the constricted portion, its subsequent progress will be easy. But if the pelvic deformity be great, portions of bone will be constantly breaking away, and on being carefully removed, a fresh purchase is to be obtained. In this way, the base of the skull will sometimes be the only part left ; in which case, the rough edges are to be carefully covered with the scalp, and the crotchet being fixed in the foramen magnum, by carefully adapting the small diameters of the bones to those of the pelvis, and exerting steady traction, the delivery is completed. If even this fails, we must have recourse to turning, or the osteotomist of Dr. Davis.

After the birth of the head, further efforts are usually required to complete the delivery of the body. A napkin may be wrapped round the remains of the head and neck, and steady but remitting traction exercised in the direction of the axis of the brim. The blunt hook may be placed alternately under each axilla, and the shoulders thus brought down. But if any considerable difficulty occurs, as the child is dead, rather than give any unnecessary suffering to the mother, it is better to pierce the thorax with a pair of scissors, and remove the viscera of the thorax and abdomen, after which, all obstacles are easily overcome.

It is plain from the above remarks, that there are some serious objections to the crotchet : namely, the danger of lacerating the structure of the mother, or the fingers and arm of the accoucheur, if it accidentally break away from its hold. To obviate this danger, the craniatory forceps have been recommended, (see Forceps, Obstetrical,) and the guarded crotchets of Dr. Davis. The following sketch exhibits the application of the best of his instruments.

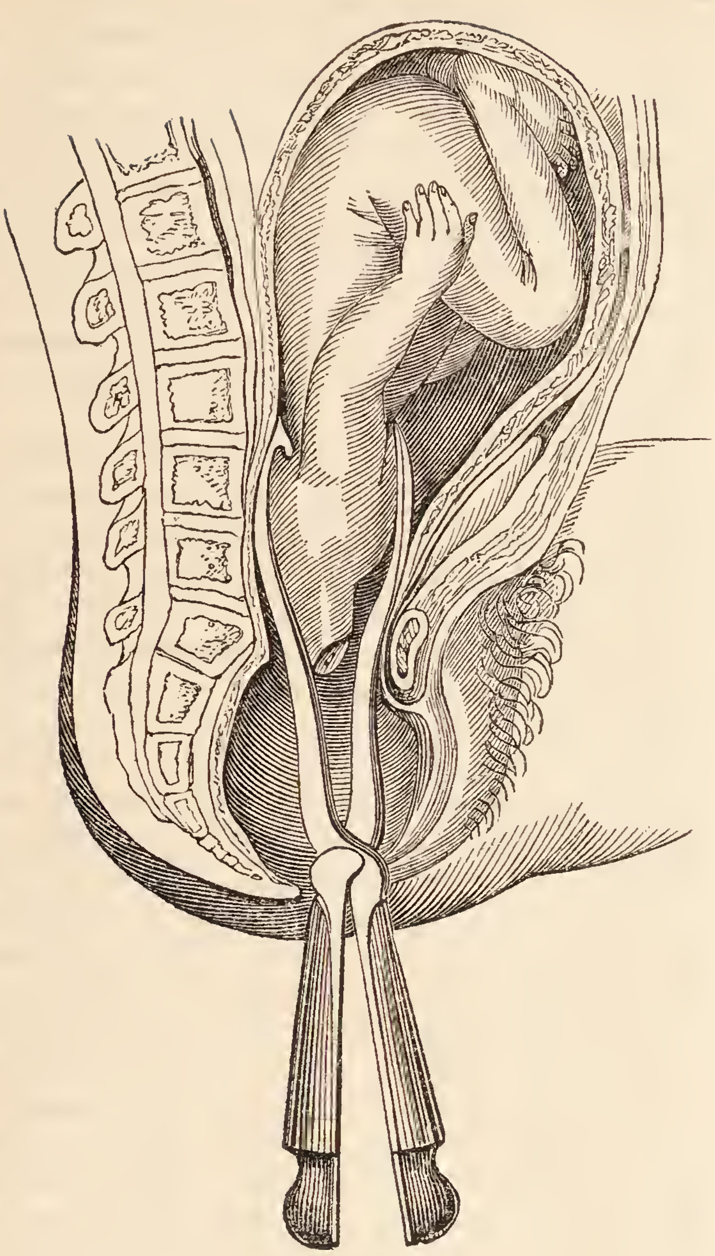
Fig. 187.



The crotchet part of this instrument is armed with three stems or prongs, to be introduced into the interior of the skull. A more ample purchase, with less probability of fracturing the skull, is thus obtained, than if the crotchet had but one large prong. These stems or prongs form an angle of thirty-five degrees with the stem : they are a little curved from the base to the point, the convexity being towards the point, the concavity towards the handle. The guard is to be passed on the outside of the head. Its extremity is hollowed out like a spoon, and perforated with three oval holes, so situated as to correspond with the prongs of the crotchet, and is prevented from slipping by rough pieces of steel placed between, and behind the perforations. The handles and locking apparatus resemble those of the common forceps. There are, probably, many cases where these instruments might be employed with advantage, but further experience is required to prove whether they answer the purpose intended, and whether they are not open to the same serious objections as the craniotomy forceps.

Dr. Davis has also introduced another instrument, which he calls the body-crotchet, for the purpose of extracting the body of the child, after the previous removal of the head. The annexed cut gives a very good idea of

Fig. 188.



the application of this instrument, which scarcely requires description. The crotchet branch is to be most carefully adjusted some distance above the brim of the pelvis, and being firmly fixed on some part of the child's body, the guard is to be passed opposite to it, and the locking of the blades being adjusted, the handles are to be firmly connected by a tape; the extraction is then to be most carefully commenced, and continued in the axis of the pelvis. As we remarked with regard to the guarded crotchet, further experience is required to prove the value of this body instrument. It is very rarely that the common crotchet will not answer every purpose, provided it be carefully used in a suitable case.

For further information on the subject, see CEPHALOTOMY and OSTEOTOMIST, and for the cases in which embryotomy operations may be required, the reader is referred to the article PARTURITION.

(*Thomas Spencer Wells.*)

CRYSTALLINE BODY.

The crystalline body, comprehending both lens and capsule, has most important connexions with all the internal parts of the eye. Lying in the fossa which the vitreous body presents in front, the crystalline is closely adherent by the posterior wall of its capsule to the hyaloid which lines that fossa. The anterior wall of its capsule is invested by the membrane of the posterior chamber of the aqueous humour, which is reflected upon it from the ciliary processes. Around the circumference of the crystalline is the canal of Petit and the zonula ciliaris; the folds composing the latter are dovetailed with the ciliary processes. The united folds of the ciliary zone and ciliary processes overlap the edge of the crystalline in front, but do not adhere to it, there being betwixt its circumference and the anterior edge of the ciliary zone, a ring of transparent hyaloid, called *zonula lucida*, broader on the temporal than on the nasal side. Extending from the ciliary body, all round, to the circumference of the crystalline, is the corona of minute elastic filaments called *orbiculus capsulo-ciliaris*. Furthermore, the close proximity of the pupillary margin of the iris to the crystalline is not to be forgotten, as adhesions from effused lymph very frequently take place between the two.

Vessels of the crystalline body.—A branch of the central artery of the retina runs through the vitreous body, in what is called the hyaloid canal, to the posterior wall of the capsule, on which it ramifies. The branches radiate to the circumference of the crystalline, where they join branches from the ciliary zone, and a vascular net-work is formed from which branches proceed to the anterior wall of the capsule, ramifying towards the centre, and at the same time anastomosing with each other by arches. Except in the fœtal state, and in disease, the vessels just described are invisible.

From the above it will be seen that the crystalline has connexions with the interior parts of the eye, analogous to what the cornea has with the exterior parts; and from this it may be inferred, that, on the one hand, the crystalline must be equally exposed to the spread of disease; and that, on the other, should it happen to be the primary seat of disease, the surrounding parts cannot fail being more or less implicated.

Injuries of the Crystalline Body.—The crystalline body is liable to suffer from two kinds of injuries. It may be directly wounded by a foreign body or instrument which has penetrated the eyeball, or it may have its connexions so broken up in consequence of a blow upon the eye or its neighbourhood, that dislocation takes place either immediately or consecutively. Dr. Mackenzie mentions, that he has repeatedly seen grains of gunpowder propelled through the cornea into the lens, so as to produce cataract.

(*a.*) *Wounds.*—Wounds of the crystalline body, even when simply punctured or incised, give rise, it may be said invariably, in the human eye[1] to lenticular opacity, and often to more or less capsular opacity in the seat of the wound. After a wound of the capsule, the soft exterior part of the lens is sometimes seen to ooze out in the form of a semi-opaque flock.

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[1] Experiments which have been made on certain of the lower animals, dogs for instance, show that wounds of the crystalline body are not, in them, so readily followed by opacity.

The wound of the capsule may unite and the opaque lens remain; but when, by reason of its extent, the wound does not close, the lens is gradually dissolved, and disappears, as after the operation for cataract by division. In such a case the injury is both bane and antidote.

The wound of the eye, of which that of the crystalline is merely a part, is usually followed by an attack of internal inflammation, sometimes very severe and destructive. This may take place even after needle operations for cataract, in which the wound is as simple as possible. The membrane of the aqueous humour and the iris are, in the least complicated cases, the parts commonly most affected; and the consequence is, effusion of lymph into the pupil.

(*b.*) *Dislocations of the Crystalline.*—Sometimes a wound of the capsule is followed by dislocation of the lens, an accident which ocsionally happens during needle operations for cataract. The capsule may also be burst by a blow, and the lens be forced out of its situation.

The extent to which the crystalline is removed from its place has been found to vary in different instances. It may be merely so far separated from its connexions, as to press the iris forward, and thus obliterate the posterior chamber and diminish more or less the anterior, or it may be entirely dislocated into the anterior chamber. Cases again have been met with in which the lens has escaped through a breach in the cornea, from a blow, or, having been forced through a laceration in the sclerotica, has been found lying underneath the conjunctiva.

The capsule may accompany the dislocated lens; but this will seldom be the case in a previously healthy eye, because the connexions of the capsule are everywhere so close. But it sometimes happens, that the connexions of the capsule having gradually become dissolved in consequence of some slow morbid action in the interior of the eye,—the result, sometimes, of no particular cause, sometimes of a blow previously received—the slightest concussion is sufficient to cause dislocation of both it and the lens. In such a case, as a dissolved state of the vitreous humour is a frequent concomitant change, the dislocated crystalline may fall back into it, or through the pupil into the anterior chamber. Sometimes the connexions of the crystalline not being wholly broken up, it remains *in situ*, but is tremulous; or it is retained at some part of its circumference merely, and there moves as a door on its hinges.

A dislocated crystalline very generally becomes opaque, but not always; for instances are related, not only of a lens and its capsule, but also a lens alone, being dislocated into the anterior chamber, and remaining there for some time without losing transparency.

It generally happens in those cases, in which the connexions of the crystalline are slowly dissolved, that opacity also takes place. Sometimes the lens is wholly or in part absorbed, and the capsule, thickened and opaque, alone remains. This is called *cataracta cystica;* and, as it is seen bobbing up and down, or floating in the dissolved vitreous humour, the epithets *tremulous* or *natatalis* are sometimes superadded. A cystic cataract may occasionally fall through the pupil into the anterior chamber, and again slip back.—See farther on this subject the Article CATARACT.

Very often during needle operations for cataract, the crystalline, from its bonds of connexion having become much weakened, falls down into the dissolved vitreous humour on the first touch, and when extraction has been attempted in a similar state of eye, the lens, instead of coming out, has sunk down behind the iris.

Treatment.—Wounds of the crystalline body are not of themselves the immediate subject of treatment, but it is the internal inflammation, which is so apt to result, that requires to be carefully attended to. A dislocated lens is frequently the cause of keeping up inflammation, and ought to be extracted; and this, even though there should be no irritation at the time, if from its hardness it is not likely to be absorbed; because, acting as a foreign body, it is apt sooner or later to give rise to inflammatory action. Mr. Barton, of Manchester, adopts this practice even in punctured wounds of the capsule, without dislocation, in order to obviate the capsular cataract and contracted pupil, which are so commonly the effects of such an injury.

The propriety of removing a lens forced out of the eyeball through a rent in its coats, and lying under the conjunctiva, is obvious.

The degree of vision preserved after injury of the lens will depend, of course, on the state of the other parts of the eye; but to enter into the discussion of which would be out of place here.

Inflammation of the Crystalline body.

This is, in general, a chronic disease, and the symptoms are by no means strongly marked.

From the connexions of the crystalline, it seldom happens that inflammation is confined to it alone, but it will generally be found that other parts of the eye are more or less implicated; sometimes both walls of the capsule are inflamed at the same time, but not unfrequently one is affected independently of the other; this is not surprising considering that the anterior and posterior walls of the capsule are connected with different parts of the eye, and derive their vascular supply from different sources; a fact, which, on the other hand, explains how different parts of the eye should be sympathetically affected in inflammation of the anterior wall of the capsule, from those affected in inflammation of the posterior wall. Thus, whilst it is the choroid, iris, and ciliary body which are most affected along with the anterior, it is the retina and vitreous body which are more particularly involved with the posterior wall.

In either case, the lens itself suffers more or less, and enlarged vessels are sometimes seen prolonged into it. Professor Walther[1], to whom we owe the first notion of inflammation of the crystalline body, remarks, that in inflammation of the anterior wall of the capsule, vessels shoot backwards into the substance of the lens; whilst in inflammation of the posterior wall of the capsule, vessels shoot forward.

Inflammation of the anterior wall of the capsule.

The symptoms of inflammation of the anterior wall of the capsule have a general resemblance to those of chronic iritis; the iris being more or less affected, especially the membrane investing its posterior surface.

Objective symptoms.—There is not much external redness. The iris is slightly discoloured and dull, and the pupil, bordered by a fringe of uvea, is somewhat contracted, irregular in form, and either fixed or very sluggish in its movements. On close examination, patches of opacity, some of them tinged of a brown colour, may be seen on the anterior wall of the capsule with minute vessels terminating in them. If belladonna be applied, and the pupil yields to its influence, the few red vessels, which were previously seen coming from behind it, are discovered to be derived from what appears to the naked eye brownish red patches on the crystalline, forming an interrupted circle concentric with the pupil. By the help of a magnifying glass, however, of one inch, or one half inch focus, these patches are discovered to be vascular net-works tending in their ramifications, as is the natural course of the vessels on the anterior wall of the capsule, from the circumference towards the centre. Between these vascular net-works on the anterior wall of the capsule, and the membrane on the posterior surface of the iris, vessels supported by bands of adhesive lymph extend.

Subjective symptoms.—The dull pain in the eye and head which attends this inflammation is seldom such as to cause much distress; and any intolerance of light is so little that the examination of the eye is not attended with much uneasiness. Muscæ volitantes, and photopsia, however, sometimes disturb the patient, and the dimness of vision is greater than the mere suffusion of the lens would alone indicate.

In the early stage of inflammation of the anterior wall of the capsule, resolution is sometimes brought about; but, when the disease has existed for some time, it remains very obstinate.

Inflammation of the posterior wall of the capsule, and of the hyaloid membrane.

The posterior wall of the capsule, rendered visible by the opacity which attends the inflammation, presents a concave surface, on which, according to Walther, vessels are seen radiating from the centre. I have not seen any case in which red vessels were visible; but I have seen radiating streaks of opacity in the situation of the posterior wall of the capsule, somewhat similar in arrangement to the vessels represented in Professor Walther's figure of inflammation of the posterior wall of the capsule. The impairment of vision, photopsia and headach in this case pointed to a concomitant affection of the retina; such cases are described as inflammation of the hyaloid by Dr. Mackenzie. Dr. Ammon observes that opacity of the posterior wall of the capsule is very frequently the precursor of disease of the vitreous body, and of the retina, or is a consequence of it. This he supposes depends on a diseased action of the central artery, perhaps, also, on a morbid change of this delicate vessel itself. Dr. Mackenzie in his chapter on the subject also remarks, "The vessels of the posterior hemisphere of the crystalline capsule are derived from the central artery of the vitreous humour; we can scarcely suppose the capsule to be concerned in inflammation without the hyaloid at the same time participating in the disease."

The changes which take place in the crystalline body in consequence of inflammation, are opacity, dissolution of the lens, suppuration, as in that variety of cataract called *cataracta cum bursâ ichorem continente*, and ossification.

Treatment—The general treatment employed in internal inflammations of the eye, viz. depletion, mercury, counter-irritation and belladonna, in the early stage, and tonics in the latter stages, are the remedies which suggest themselves; but their employment must be regulated and modified according to the circumstances of the case.

Dr. Mackenzie mentions the following circumstances in regard to a case of inflammation of the anterior hemisphere of the capsule, which he treated. On the first day of his being called in, two minute spots were seen projecting from behind the edge of the pupil. Next day there were five. In the course of a week, the symptoms totally disappeared, under the employment of venesection, leeches, calomel with opium, and belladonna. The mouth was made very sore. In the chronic stage, Dr. Mackenzie confesses, however, that this inflammation has in his hands proved one of the most obstinate.

(*T. Wharton Jones.*)

CUPPING. *Cucurbitula*, Lat. *ventouse*, Fr. *Schröpfkopf*. By cupping is understood the application of one or more glasses on some portion of the skin, in order, by forming a vacuum beneath the glass, and taking off the pressure of the atmosphere, to determine to such parts an afflux of fluids from the neighbouring capillaries. For the purpose of derivation or revulsion, this momentary engorgement is kept up until rubefaction is produced.

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[1] Abhandlungen aus dem Gebiete der practischen Medicin; vol. i. Landshut, 1810.

The glass is then detached by inclining it a little, and pressing the skin on one side till the air is admitted. This is termed *dry cupping*, the *ventouse sèche* of the French, and *trockene Schröpfkopfe* of the Germans. When the skin is scarified in order at the same time to draw blood, it is called, by the former, *ventouse scarifiée*, by the latter *blutige Schröpfkopfe*.

The scarification is effected by means of an instrument resembling a box in shape, into which a number of lancets are so fixed as to be subject to a spring. The flat surface of the box, which is perforated to admit of the movement of the scarificators, being applied on the skin, the incisions are made at a stroke, by letting go the spring.

The depth of the incisions can be regulated to a certain extent. The quantity of blood obtained in this way would, however, be very small, if means were not employed before-hand, of producing a congested state of the capillary vessels of the part about to be scarified. This is done by dry cupping the parts for about a minute before the scarificators are applied. The same glasses may be employed for the evacuation as for the dry cupping.

The degree of vacuum required in the glass is produced by holding it for a moment over the flame of a spirit-lamp; it is then applied instanter to the skin. The success of the operation, especially in regard to the quantity of blood to be abstracted, depends much on the celerity of this step. The blood spirts out immediately from the punctures, and continues to flow. The freedom of its evacuation may be prevented by the excessive pressure of the rim of the glass checking the arrival of the blood from the surrounding parts, or by the heat of the blood itself still further rarefying the air within the glass, and its vapour filling up the space, the elastic tension within being thus rendered equal to the external pressure, the blood ceases to flow and the glass soon drops off. When this occurs, the blood must be wiped off from the punctures, and the glass rinsed with warm water, and applied as before.

Some operators prefer the Bdellometer, or a cupping-glass, which is provided with an exhausting pump, as more convenient, prompt, and certain in its effect. When this instrument is used, the edge of the glass is greased to facilitate its adhesion to the skin, and applied first; the pump is then screwed on to it, the stop-cock is then opened, and the air of the glass being exhausted by a few strokes of the piston, the skin swells up under the diminished pressure. In either way, by the number of glasses employed or their re-application, the desired quantity of blood may in general be obtained by an expert operator, provided the temperature of the apartment be not so low as to check the cutaneous circulation. Indeed the certainty on this point, is a good reason, in many cases, for preferring cupping to leeches, which are often not to be had, and the bites of which sometimes are attended by undesirable consequences. Dr. Osborne has proposed an extended plan of scarification in cupping, by means of an instrument which he calls a *polytome;* instead of simple lancet-punctures, this instrument makes incisions of such length as the operator pleases, by being drawn along the skin.

On the removal of the cupping glasses, often before, the bleeding ceases; the small punctures may be dressed with a piece of soft linen rag, or of gold-beater's skin.

CURETTE or David's spoon, an instrument used in the operation for Cataract. See Cataract.

CURETTE, the name given by the French to a small instrument, shaped at one end like a scoop. It is employed in the extraction of foreign bodies, from the urethra, meatus auditorius, nostrils, eyelids, &c. On a larger scale it is used in the extraction of bullets, and vesical calculi.

CURVATURE OF THE SPINE. See Vertebral Column.

CYST. (From κυστις, a sac or bladder.) An abnormal membrane forming a shut sac, commonly an adventitious formation, but in rarer instances resulting from certain changes in pre-existing tissues, and containing materials either fluid or solid secreted by itself (as serosity, meliceris, atheroma, &c.), exuded from surrounding structures (as blood), or introduced from without (as bullets, pieces of cloth, &c.). In a surgical point of view, cysts derive their importance more from the nature of their contents than from their own particular structure; the practical consideration of the subject, as well as such general remarks on the anatomy and physiology of these membranes, as are necessary for the just comprehension of the phenomena to which they give rise, are therefore, in accordance with general custom, deferred to the article Tumors, Encysted. See also Cancer (p. 604.), Mamma, and Ovary, diseases of.

CYSTITIS, (from κυστις, bladder,) *Harnblasenentzündung*, Ger. Inflammation of the urinary bladder. In the article Bladder, the anatomical structure of this viscus is described. Composed as it is of several tunics, held together by cellular tissue, and lined with a mucous membrane, every pathologist must be aware that these several tunics are liable to be attacked by inflammation, separately or all together, partially or universally; and that the symptoms must vary according to the extent and intensity of the invasion, and the nature of the exciting cause. It will be therefore obvious, that the symptoms themselves will present considerable variety, and for this reason it is liable to be confounded with inflammation of the prostate, and even with retention of urine, which sometimes accompanies it as a symptom.

Cystitis is by no means frequent as a primary disease, and when it occurs as such, it is most commonly caused by injuries arising from accident, or from surgical operations, by poisoning by means of cantharides, by the metastasis of severe gonorrhœa, by the pressure of the head of the child in protracted labour, &c. Symptoms of cystitis occur secondarily in connexion with affections of parts more or less distant, as the kidneys, ureters, urethra, uterus, rectum, &c., and finally from the presence of foreign bodies.

This affection, in its acute state, is characterized by more or less exaggeration of the sensibility and contractility of the bladder; there is pain in the bladder, extending towards the urethra, the ureters, the rectum, which is greatly augmented by pressure; and if the inflammation occupies the muscular tunic extensively, its contractility is so impaired, that urine accumulates in the bladder, and causes intolerable anguish. The patient is tormented whether there be any water in the bladder or not to void it, and he wearies himself, and aggravates the symptoms with incessant efforts for that purpose. But a few drops of turbid, thick, and reddish urine are thus expelled, accompanied with a sensation of scalding or burning along the urethra. The straining occasionally extends to the rectum, and small portions of fæces are voided, and the end of the gut itself is prolapsed. When the urine accumulates in the bladder, the feeling of tenesmus has no intermission, and a hard tumour is felt rising in the hypogastrium, which cannot be pressed without producing intense agony. The fever runs high, the pulse is full, frequent, and hard; the tongue and fauces furred and dry; and sometimes there is nausea and even vomiting. When these symptoms go on unchecked, the inflammation is propagated to the ureters, kidneys, and peritoneum; and after an interval, which varies from two to six or eight days, according to the violence of the attack, hiccup finally comes on, the pulse becomes small and thready, the muscles are agitated with subsultus, clammy sweats break out, and the patient sinks into a comatose state and dies. When successfully combated, the symptoms gradually decline in severity, the fever is subdued, the pain diminishes in violence and frequency, the intervals of voiding the water are lengthened, the urine itself is less discoloured and mucose, and is secreted in greater quantity.

Sometimes, however, the disease, though abated in some degree, continues under the form of a muco-purulent secretion from the mucous lining of the bladder, which secretion, after persisting for some time, may be ultimately cured. More rarely still, the irritation is kept up in some portion of the vesical walls, and matter is formed either in these walls, or in the cellular tissue which unites the bladder to the neighbouring organs. When this is the case, there will be generally slight rigors, with fever, a sense of weight and pain in the pelvis, and of difficulty in voiding the urine. If these symptoms yield, and the patient experiences great relief, after a quantity of pus has been suddenly voided with the water, the nature of the case is clear. Here, too, the recovery may be not only prompt, but complete. If, however, the matter becomes diffused in the cellular tissue of the pelvis, and points in the rectum, perineum, groin, or neighbourhood of the pelvis, the case is really serious, and the patient is but seldom fortunate enough to be able to bear up against the pain and exhaustion he has to undergo. Ulceration of the mucous lining of the bladder itself to any extent is extremely rare. It does, however, occur now and then, under peculiar circumstances, and occasions the utmost distress, especially when it becomes necessary to employ instruments to evacuate the contents of the bladder.

Cystitis, when carried to a high degree of intensity, may terminate in gangrene, not only of a portion of the bladder itself, but of such other parts as the inflammation may have extended to. The author of this paper had once an opportunity of observing a case of gangrene of the bladder and ureters, with Sir A. Cooper. The invasion of the disease was extremely sudden, and its progress rapid. Several hours before the patient's dissolution, all pain had ceased, but the gangrenous odour was very strong. The pulse continued to sink, the body was covered with a clammy offensive sweat, and the urine voided was insupportably fetid; the intellectual faculties remained unclouded to the last.

From the preceding description, which embraces the condition of the bladder, attacked extensively and simultaneously in the several structures of which it is composed, it will be easy to form an idea of the modifications which the symptoms will undergo, when the inflammation is limited to a particular region, or tissue of the viscus. When the peritoneal region is the seat of phlogosis, the pain on pressing the hypogastrium is extremely severe, and there is danger of its being propagated to the serous membrane; but the vesical tenesmus, and constant straining are by no means so severe as when the neck or *bafond* of the bladder is the seat of the inflammation. In the latter case, the symptoms enumerated in the general description are present, with pain, and a sense of swelling and tension in the perineum, retention of urine, burning heat in the urethra, and frequent erections. The urine is hot and bloody, and the introduction of the catheter is extremely painful. The anus, too, is extremely sensitive, and the fæces are retained from the fear of pain, and the difficulty of their excretion, owing to the tumefied state of the parts. If the inflammation occurs in the region of the ureters, pain is felt extending along their course to the kidneys, and it is said that the occlusion of these conduits, and the accumulation of the urine in them, may be the consequence. Sir B. Brodie observes correctly, that the ureters are more or less dilated, after inflammation of the bladder.

Acute cystitis however may occur in each separate region of the bladder, without involving any but the mucous membrane. In this case, the symptoms generally are of a more moderate character, their progress slower, and the constitutional disturbance comparatively slight. The case, nevertheless, may prove serious ; and there is, besides, the grave liability of the partial, being converted into the general cystitis, which cannot be too vigilantly guarded against. The sudden and spontaneous attack of cystitis is but rarely perpetuated under a chronic form. This affection is mostly secondary, as for example when symptomatic of stone in the bladder, disease of the kidney, enlargement of the prostate gland, strictures of the urethra, and in the case of chronic catarrh, as it is called, in the aged. The most general and prominent symptoms are dull pain or sense of weight in the region of the bladder or perineum ; frequent, painful, and often difficult micturition ; urine turbid, whitish, mucose, ammoniacal, or fetid. The urine, on cooling, deposits its mucus as a whitish, ropy, and viscid substance, which adheres to the urinal. In mild cases, it retains its acid qualities, and reddens the litmus paper ; but when the viscid deposit abounds, and the urine is lactescent or opaline, it will be often found to be alkaline, and to deposit phosphate of lime, of the consistence of plaster, on any substance with which it may be for a long time in contact. Usually, the general health is at first unaltered. In the progress of the disease, the appetite, sleep, and strength are impaired, the pulse is irregular, the tongue brown and dry, the thirst urgent, shiverings occur, with exhausting sweats, the urine is brown, sanious, and intolerably offensive, and the body wastes more or less rapidly according to the severity of these symptoms. The structures of the bladder sooner or later experience the effect of the prolonged irritation, and the frequent excitation of its contractility, its muscular, and indeed all its other tunics become partially or generally hypertrophied, and its capacity as a reservoir is thus diminished. If to this, the existence of other pathological alterations be added, such as the growth of a fungous, vegetatious ulceration of the surface of the bladder, as indicated by a sanious, purulent, and excessively fetid discharge, life is rapidly destroyed by the accumulated miseries to which the patient falls a victim.

Chronic cystitis is, however, occasionally observed, not only in a mild form, but having its progress interrupted by lengthened intermissions, during which all, or almost all the inconveniences attending it disappear. This often happens during fine, genial weather, but the misery returns with cold, moist weather, or upon slight neglect of regimen.

On examining the parts in subjects who have been afflicted with acute inflammation of the bladder, which has run a rapid course, the changes are found to be few. The mucous membrane is injected, presenting red, vascular arborizations, or dark, gangrenous patches ; it is thickened, or attenuated ; occasionally, it is softened. Sometimes, too, small collections of pus are met, either in the vesical walls, or cellular tissue adjacent. But in chronic cystitis, the pathologist cannot help being as much struck with the great diversity of the organic alterations it induces, as he had been with that of the symptoms which occur in its progress, in different individuals ; and this is the case more especially in the instances where the cystitis, being but a secondary effect of a pre-existing cause, such as stone in the bladder, disease of the kidneys, &c. it continues to fluctuate from the chronic to the acute state, and *vice versa*, according to the modifications which the complicating affection undergoes. The importance of this point of view to the practical surgeon cannot be overrated, as on it depend the measures he may adopt, and, in many cases, the ultimate success of his treatment. Chronic cystitis, as an affection *per se*, unquestionably presents a variety of indications ; but, as a secondary effect of some other disease, it is often so completely thrown into the shade, that its consideration is entirely subordinate to that of the primary affection.

The structural alterations arising in the progress of chronic cystitis are hypertrophy, often extending to the ureters and pelvis of the kidneys, and generally with diminution of the capacity of the bladder, sometimes without this diminution. In the progress of the thickening, the thinnest portions of the vesical walls, being subject to frequent pressure from the urine, yield, and thus are formed those inequalities of surface, which authors describe as the *sacs*, or *pouches*, and *columns* of the bladder. I have seen, in a case where numerous calculi were found after death, the back wall of the bladder separated into two muscular plans, the web of the posterior one being completed by the peritoneum, while the anterior plan was in a manner riddled with openings by which the accidental and natural cavity communicated. On cutting this portion of the bladder, and pressing it between the fingers, pus exuded in small quantity from different points. In the protracted and ever-recurring irritation of the bladder, arising from the presence of a stone, the consistence of its tissue becomes sometimes horny, sometimes close and dense, and in appearance parenchymatous, like that of the unimpregnated uterus. The mucous membrane feels pulpy and thickened, and is, universally or partially, injected, and of a greyish, greenish, darkish red, purplish, or blackish hue. From the extension of the effects of the irritation to the ureters and kidneys, they are also enlarged, inflamed, and softened, and small abscesses, or rather collections of a muco-sanious fluid, are found in the substance of the kidney.

To be able to establish readily the differential diagnosis of the various forms which cystitis, whether acute or chronic, may put on in reference to causes, is a task of much discrimination, and an accomplishment of no inconsiderable value for the surgeon. Books on this point are, it is true, very encouraging; but the duty of the practitioner is, nevertheless, an arduous, often an anxious one, demanding, as it does, on his part, a ready, almost an intuitive familiarity with its numerous and diversified complications. The nature and bearing of the local symptoms can only be determined by information, precise and circumstantial in regard to their history, and by exploration of the other organs which may participate in the disease either as cause or effect. When our information on these points is complete, we may form our prognosis in the commencement or early stages of the disease with some assurance. Thus, the acute cystitis arising from a wound, a blow, or a fall, will vary in its local symptoms according to the situation and function of the part injured. If the inflammation interests but the mucous membrane only, the prominent symptoms will be the painful and frequent micturition, with more or less abundant mucous deposit. If the attack has followed a fit of gout or rheumatism, and invades the muscular structure, the symptoms will be retention of urine, with deep-seated and severe pain in the region of the bladder. If the affection is circumscribed within the region of the neck of the viscus, and extends to the urethra and prostate, it is ushered in with sharp rigor, and malaise, followed by fever, with frequent pulse, hot and dry skin, inappetency, and sleeplessness. Sometimes the perspiration after the hot stage is abundant, at other times but inconsiderable or partial. If the attack take place on the part of the bladder covered by the peritoneum, pressure upon it causes intense pain, it feels hard and like a ridge to the touch, but the excretion of the urine is not particularly painful, though it may be frequent. In the more advanced stages, when the inflammation has invaded all the tissues together, the power of making any distinction in reference to origin or situation is, of course, out of the question. Under such circumstances all the symptoms are aggravated, the rigors succeed each other, the pulse becomes accelerated, tremulous, and intermittent, the skin dry and hot, the tongue brown and glassy, the patient is agitated and anxious, and wanders from time to time, though his consciousness remains; the urine muco-purulent, flocculent, scanty in quantity and of a most offensive odour; the abdomen is swelled, and painful to the touch, especially in the hypogastric region, and hiccough supervenes, with cadaveric features, low delirium, and death.

Treatment.—In acute cystitis, particularly in the young and robust, prompt and vigorous measures are imperatively required; bleeding at the arm or in the foot, and repeated according to necessity, with leeching in the perineum, anus, and hypogastrium, or cupping in these situations, or over the loins, constitute the resources of the first order. To these, the warm bath, emollient fomentations, and mild enemas should come in aid; and retention of urine, if present, should be relieved by the catheter. Internally, calomel and opium should be administered in doses of two or three grains every two or three hours. When the attack has arisen from the metastasis of gout, and there are symptoms of hepatic congestion present, great relief will be obtained from the use of the acetous extract of colchicum, combined with a mild mercurial. When the symptoms have yielded, external stimulants should be had recourse to, such as vesicating or rubefacient applications to the neighbouring regions, dry cupping, dry friction, &c. Demulcent mucilaginous fluids, such as barley or gum-water, linseed-tea, or marshmallows-tea, should be freely allowed, and will be most relished, and satisfy the thirst best, if given cold.

If the disease has been caused by poisoning with cantharides, in addition to the general means mentioned, camphor julep, or emulsion, will be a proper drink, and should be taken in considerable quantity. The patient should also be constantly fomented, or placed in the warm bath for hours.

The disease in the chronic form but seldom requires, and can be therefore but seldom benefited by active measures. Perhaps the utmost extent to which they can be safely allowed, even in those cases where an active irritation is occasionally manifested by signs of local congestion in the neighbouring parts, and high-coloured, strongly acid, highly viscid urine, should be limited to the local abstraction of blood from the perineum, or hypogastrium, by cupping or leeches, or from the prostate gland itself, by leeching within the anus, a sort of depletion which is readily effected by means of a long scoop. Constipation should be carefully obviated by castor-oil in moderate doses, and emollient bulky enemas; but purging should be avoided. The patient should be confined as much as possible to the recumbent posture.

The internal medicines upon which the most reliance is placed are of a balsamic, astringent, or sedative character. Amongst these, the Diosma has been of late years steadily gaining a reputation for its efficacy in this disease. The Tolu, Peruvian, and capivi balsams are also much employed. Chian turpentine may also be ranged in this class. Singly, or in combination, these remedies are found to agree very well. The remedies of a tonic or astringent character are the *pareira brava*, the *uva ursi*, and the *lythrum salicaria.* They are certainly beneficial in the purely chronic state of the affection, as in the catarrhal condition of aged persons; but their value is, to say the least, very doubtful when there is much pain, heat, and scalding, with alkaline urine and accelerated pulse.

The next class of remedies is that of narcotics, amongst which opium, when not forbidden or controlled by individual idiosyncrasy, is entitled to the first rank. Indeed, opium in one form or another, or combined with the balsamic or astringent remedies, will prove generally of great benefit in this affection. It may be exhibited, as the Dover's powder, under which form it mostly agrees very well, or as a watery extract, as Batley's sedative liquor, tincture, or crude opium;

these latter are most advantageously administered by the rectum. The muriate of morphine, exhibited by the mouth, is a very valuable preparation. In some cases greater benefit is derived from other narcotics than opium. These are the extracts of henbane, conium, lettuce, hop, and compound tincture of camphor; and their good effects may be much increased by judicious combination with the balsams and tonics. The tar-water has also been favourably spoken of. The use of alkalies must not be resorted to indiscriminately. If the digestive organs are deranged, and the urine is acid, a prudent and moderate exhibition of them may be attended with benefit. In the advanced stages of the complaint, when the urine is alkaline, and the general symptoms are evidently of untoward character, much benefit may be obtained from the use of mineral acids.

The diet should consist chiefly of farinaceous substances of light and easy digestion. Fermented liquors should be abstained from. But sound wine or beer, and animal food, may be allowed when the digestion or general health demand it. Warm clothing and flannel next the skin are important; the feet especially should be kept dry and warm.

Soothing injections in the subacute stages of this affection, as well as of medicated ones in the purely catarrhal condition, have sometimes proved useful auxiliaries; but in some cases, even where performed with all possible gentleness and proper precaution, their effect has rather tended to harass and fatigue the patient.

When the disease depends on stricture, stone in the bladder, &c. the cure will be often effected by the removal of the cause. This, however, may be sometimes unadvisable, as, for instance, in the case where a calculus may have already produced such extensive ravages, locally and generally, as to contra-indicate peremptorily any attempt to remove it by an operation.

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(*Wm. B. Costello.*)

CYSTORRHŒA, the *catarrhus vesicæ* of the old surgeons, characterized by the secretion of mucus from the bladder, which with the urine is generally voided with some difficulty, though mostly without pain. (See Cystitis.)

CYSTOTOME. See Lithotome.

CYSTOCELE, Hernia of the bladder. See Hernia.

CYSTOTOMY (from κυστος the bladder, and τεμνω I cut), is the operation of cutting into the urinary bladder from a contiguous mucous, or cutaneous surface of the body. This operation may be required to relieve the bladder under complete retention of urine; it has also been performed for removing coagulated blood from the bladder, but improperly, as a syringe would have accomplished the same object by suction through an urethral tube. Where the bladder is occupied by benign polypous tumours, arising from its lining membrane, cystotomy is applicable, if the difficulty of forming a correct diagnosis can be overcome. Le Cat invented instruments for such an emergency; Callisen has sanctioned their employment; Warner, Covillard, Lassus, and others, have actually performed the operation, removing polypous tumours successfully; and many surgeons must in the course of their practice have felt the need of such a resource. Foreign substances detained in the bladder, from whatever source derived—whether introduced from without, or originating within the body—may call for this operation; but by far the most frequent occasions for its performance are created by the presence of calculous concretions of considerable size. See Lithotomy, under which head the different methods of reaching the urinary bladder by incision will be detailed. (*J. G. Crosse.*)

D.

DACRYOADENITIS, inflammation of the lacrymal gland, from δακρυω, *to weep*, and ἀδην, *gland*.—See Lacrymal Organs, Diseases of.

DACRYOCYSTOBLENORRHŒA, Blenorrhœa of the lacrymal sac, from δακρυω, *to weep*, κυστις, *a bladder or sac*, βλεννα, *mucus*, and ῥέω, *to flow*.—See Lacrymal Organs.

DACRYOCYSTITIS, Inflammation of the lacrymal sac, from δακρυω and κυστις.—See Lacrymal Organs.

DACRYOHÆMORRHYSIS, Sanguineous lacrymation, from αἱμα, *blood*, and ῥεω, *to flow*.—See Lacrymal Organs.

DACRYOLITES, A name proposed by Professor Walther for concretions deposited in the lachrymal passages, from δακρυω and λιθος.—See Lacrymal Organs.

DACRYOMA, from δακρυω, I weep.—A name employed by Vogel to designate the epiphora produced by the occlusion of the puncta lachrymalia.

DACTYLION, from δακτυλος, a finger.—The adhesion of the fingers to each other, whether occurring congenitally, or from accident, as in burns.

DAY-BLINDNESS.—See HEMERALOPIA and NYCTALOPIA.

DECOCTIONS, from *decoquere*, to boil, are products obtained by boiling certain medicinal substances, whereby the parts soluble at the boiling temperature may be obtained. They are employed both internally and externally.

DILITESCENCE. The rapid subsidence of the redness, heat, and swelling, in external inflammation.

DELIVERANCE.—Syn. *Délivrance*, Fr. This term, though not in common use in this country, is much employed by continental writers, and is a convenient mode of expressing the expulsion or extraction of the placenta and membranes, with any clots of blood which may remain in the uterus after the birth of the child. It may be divided into simple, natural, or spontaneous deliverance, and complicated, unnatural, or artificial.

Simple deliverance is to be considered as a purely natural function, being accomplished by the unassisted powers of nature, within a short time after the birth of the child, and without danger to the mother. The process, like that of parturition, may be divided into certain stages: in the first the placenta is separated from the inner surface of the uterus by the contractions of that organ; in the second it is propelled into the cavity of the vagina; and in the third its expulsion is completed with the assistance of the abdominal and perineal muscles.

It has long been an interesting problem to decide in what manner powerful and long-continued contractions of the uterus could persist for hours, without causing separation of the placenta, especially as these organs, however connected, are but slightly adherent in the healthy state. As it is also evident, from the rapidity with which the child is destroyed by any thing which obstructs the placenta circulation, that a placento-pulmonary function is carried on in the medium of communication between the child and mother, it is difficult to explain how the uterus can contract on the placenta during labour without materially impeding this important process. Mr. Hugh Carmichael, of Dublin, has offered a very ingenious explanation of this intricate subject. After careful examination of subjects, plates, preparations, the situation of the placental souffle, and the condition of the placenta and membranes after expulsion, he states, that the natural situation of the placenta is low down on the posterior surface of the uterus. He also believes that it is formed and attached, at or somewhere near, the fundus uteri, and that it remains throughout pregnancy on the identical spot to which it was first attached, because any change of situation would necessarily disturb the circulation through it. Then as this organ is, at the close of gestation, found low down on the posterior surface of the uterus, he concludes that the uterine expansion does not take place by an enlargement in all directions; but that the portion of the fundus where the placenta was first attached, and the parts posterior to it, undergo little or no change of volume during gestation. If this be so, it is evident that the chief expansion must be that of the anterior wall, each superior portion of which arrives at and occupies the fundus, and then turns over to form a portion of the posterior parietes until the expansion is completed. The order of contraction during labour Mr. Carmichael supposes to be similar to that of expansion during gestation; the contractions "going on chiefly in the anterior part, necessarily must first draw down the fundus, which now appears on the anterior wall, and these contractions continuing and increasing in energy as they proceed, each portion of it which passes over the fundus during the expansive process, to the posterior portion, now repasses under the influence of these contractions, regaining its original position, thus diminishing its cavity, and ultimately delivering its contents[1]." Thus the posterior part of the uterus, where the placenta is situated, may remain undisturbed during the expansion and contractions of this organ; while it is supposed that if the placenta be situated above its usual position, it then comes within the range of contraction, is more or less separated, and hæmorrhage necessarily ensues.

There is no doubt that this theory, so plausibly supported by reasoning, and some facts, would, if true, clear up all difficulties on the subject. But, unfortunately, the foundations on which it is based are assumptions, the correctness of which has not been established by more extended observation. In the first place, Mr. Carmichael states, that, in ninety-seven cases out of a hundred, the placenta was situated low down on the posterior surface of the womb. Now that it is by no means uniformly attached even to the posterior surface appears from the observations of Velpeau, who, in his Embryology, gives the result of thirty-four examinations of women who died during pregnancy, or soon after delivery. In twenty of these cases it was above the orifice of the Fallopian tube, in three anteriorly, two posteriorly, six at the fundus, and three toward the cervix. Again, by examination of the secundines, and by stethoscopic phenomena, it is clearly demonstrated that it may be affixed to other parts of the uterus, and nothing unnatural occur even during a protracted labour.

With regard to the situation of the placenta, as determinable by examination of the secundines, we cannot do better than quote the observations of Dr. Doherty from the seventeenth volume of the Dublin Journal of Medical Science:—"The evidence afforded by the secundines is founded on the fact of the placenta, in the majority of instances, being expelled with the membranes reversed, and its fœtal surface downwards. When this is the case, it is obvious, the upper edge must, in its separation, have been momentarily earlier than the lower, and thrown towards the wall opposite that on which the mass was implanted, a direction the membranes, which usually remain longer adherent, tend still further to give it. But as the membranes arising from the upper edge pass over the fundus, and down the opposite wall to the os tincæ, they must be much longer than at the inferior edge; and the length of the latter will show how far from the os the placenta was actually situated. As this, however, will not be sufficient to tell us to what wall it was appended, I adopt the expedient of inserting a pin (as it lies on the bed fully expelled) into the margin close to the patient's thigh. Thus I am able to distinguish the anterior from the posterior part . . . . . . Recollecting now, that the upper edge is thrown towards the opposite wall, it must be evident if the long membrane be found at the pubal margin, the placenta must have been on the posterior wall; if at the perineal, on the anterior. The same will hold good with respect to the lateral parietes." If the uterine surface descend first, it follows, that "the secundines will tell an exactly opposite tale to what they ought. For instance, if the placenta be on the posterior wall, and the lower edge is first or simultaneously detached, it may be directed by the perineum towards the pubis; and the short membrane will then be there found, after it is expelled. This error, however, can be easily guarded against, by watching which surface descends foremost . . . . . . If the membranes be of equal length, or nearly so, all round, the placenta was, of course, at the fundus." Acting on these rules in 100 cases, it was found that

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[1] Dublin Journal of Medical Science, vol. xiv. p. 471.

in 25 cases the placenta was attached to the anterior wall;
8 —— right side below the Fallopian tube;
10 —— left, do. do.;
2 —— fundus;
54 —— posterior wall;

and of these only twenty-seven came within two inches of the lowest part of the cyst.

Though these observations probably approach the truth, we cannot but feel that they are put forward with an undue amount of confidence; for of seventy-five cases the writer has personally attended since he began to pay attention to the secundines to determine the position of the placenta, he finds no less than thirty-nine in which the result is marked as doubtful, because it was not certain that the direction of the mass had not been changed by the action of the uterus, or during its passage through the vagina. In all these cases it had been implanted low down in the uterus, but whether posteriorly or laterally was doubtful. In two cases it was near the fundus; in two partially attached over the os uteri—in both cases anteriorly; in fifteen it was high up laterally; in seven on the anterior wall; and the remaining ten were on the posterior surface, the lower border varying from one to three inches from the os uteri.

Naegele lays considerable stress on the situation of the placental souffle in determining the position of the placenta, the sound, when heard in both groins, being more distinctly audible, and over a larger space, on the side of the uterus to which the placenta is attached. In ten cases of adherent placenta the truth of this observation has been proved by the introduction of the hand; and in *all* Dr. Doherty's cases the situation diagnosticated by the stethoscope corresponded to that determined by examination of the membranes. The stethoscope can be so little employed for this purpose in private practice that we cannot speak to its value from observation, but give the result of Naegele's report of 600 cases, as his remarks differ in some degree from those of Dr. Doherty. Of these,

In 238 cases it was situated on the left side of the uterus;
— 141 —— right, do.;
— 20 no uterine sound perceptible;
— 160 so weak, and limited so completely to the inguinal region, or else so diffused over the whole surface of the abdomen, that the seat of the placenta could not be determined;
— 7 it was situated at the fundus;
— 13 ———— on the anterior wall;
— 11 ———— over the os uteri[1].

While then there is no direct proof that the uterus expands in the mode described by Mr. Carmichael, and great reason to believe that no such pulley-like contraction can take place, we have adduced sufficient evidence to prove that the placenta may be attached to parts of the uterus which indisputably contract, without separation, or disturbance of its functions. And further, it is not proved that the placenta is universally formed at, or somewhere near, the fundus; for on reference to published plates on abortion, and preparations in different museums, it is found that such is not the case, even in a majority of instances. Neither is it proved that the growth of the placenta cannot correspond with that of the uterus; the results of measurement have varied; and it appears very probable that Gendrin's theory as to the manner of growth of this mass is correct. He believes that the line formed by the reflexion of the decidua vera into decidua reflexa limits the extent of the placenta, and that the expansion of the uterus enlarges this space without interfering with the original fixture of the centre of the placenta[2].

Dr. Doherty supposes that the immunity from injury, enjoyed by the placenta during labour, is accounted for by the small space through which the fundus descends before the expulsion of the fœtal head; this slight diminution in the capacity of the uterus being sufficiently guarded against by the spaces which intervene between its lobes, which must be obliterated before its substance can suffer much compression. This view is considerably strengthened by the danger arising to the child after the birth of its head has allowed considerable diminution to take place in the capacity of the uterus, and by the observations of Joerg, of Leipsic, in the effects of too rapid birth. On these grounds this view is worthy of further investigation.

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[1] Treatise on Obstetric Auscultation, by G. F. Naegele, Trans. by Chas. West, M.D., p. 77, 78.

[2] Traité Philosophique de Médecine Pratique, t. i. p. 268.

Leaving this point then for further observation and inquiry, we can easily understand how the placenta is separated after the birth of the child. Ruysch supposed that the annular fibres around the orifices of the Fallopian tubes were formed for the purpose of throwing off the placenta; but we know that the mass is separated quite as soon when it is situated beyond the extent of these fibres. It is a body entirely passive, unable to adapt itself to the volume of the surface to which it is attached; this is diminished by the contractions of the uterus after the expulsion of the child; and the placenta being necessarily separated passes to the most depending part of the uterus; a new contraction is excited, and it is passed into the vagina, and followed by the membranes. If the vagina has not had its sensibility greatly lessened by the extension and compression during labour, the irritation arising from the presence of the secundines excites contractions of the diaphragm, abdominal and perineal muscles, by means of which the deliverance is completed. Dr. John Clarke made some observations on the length of time nature required to effect complete deliverance, and found that the average was twenty-five minutes. A small quantity of blood, either fluid or in clots, invariably accompanies or follows the secundines, but is generally not more than is contained in the uterine sinuses.

This process admits of some varieties without being rendered thereby abnormal. Thus, if the centre of the placenta be detached before the edges, blood will be effused into the cavity so formed, and a large clot come away enveloped in the membranes; or remain some time, excite new uterine contractions, and be, in its turn, expelled. Again, the period elapsing between the expulsion of the child and that of the placenta may vary considerably. Sometimes the attendant finds it in the bed before he has had time to separate the infant, while in other cases it remains for hours; and if it be merely detained in the vagina this would not constitute a form of unnatural deliverance. With the exception of the statement of Dr. Clarke, just quoted, the only statement we have met with, as to the time elapsing when the process is left entirely to nature, is by Dr. Harvie, to the following effect:—"My pupils, who deliver many poor women, according to my instructions, have of late left the delivery of the placenta entirely to nature. In general it comes away soon; but if, after waiting an hour, there be no unusual discharge, they order the woman to be carefully put to bed, and then leave her. In such cases I have not known of any placenta that has remained longer than nineteen hours; and all the women thus treated have recovered to great advantage[1]." I regret that I have not kept an account of the cases I have personally attended with reference to this point; but should consider a quarter of an hour as a fair average, as far as one can judge from recollection. The following tables, with which I have been favoured by Dr. Churchill, of Dublin, show the interval between the birth of the child and the completion of deliverance, under ordinary treatment; that is to say, the placenta is removed as soon as it has passed from the uterus into the vagina.

Of 1119 hospital cases, the interval was—

5 minutes and under in	326	cases
10 minutes in	280	„
15 —	196	„
20 —	98	„
25 —	15	„
30 —	63	„
35 —	17	„
40 —	20	„
45 —	5	„
50 —	5	„
60 —	32	„
From 1 to 2 hours in	35	„
2 „ 3 —	14	„
3 „ 4 —	6	„
5 —	6	„
6 —	1	„
7 —	1	„

Of 231 cases in private practice—

5 minutes or under in	150	cases
10 minutes in	49	„
15 —	10	„
20 —	8	„
30 —	14	„

The following table, from the *Lancet*, May 23, 1840, shows the result of the practice in Queen Adelaide's Hospital:

In 4 cases the interval was from	1 to 5	minutes.
23 —	5—10	„
17 —	10—15	„
13 —	15—20	„
24 —	20—30	„
2 —	30—40	„
2 —	40—60	„
3 —	1 to 2	hours.

DUTIES OF ATTENDANT IN SIMPLE DELIVERANCE.

Very various opinions have been entertained with regard to the duties of the accoucheur between the birth of the child and the expulsion of the secundines. It does not appear, from the writings of Hippocrates, that any means were taken to expedite deliverance; and when the placenta was retained, though medicated substances were introduced into the vagina, and antispasmodic medicines given, yet manual assistance is not advised. Celsus, however, recommends that, immediately after the birth of the child, the secundines and any coagula are to be brought away by the hand: "Medicus deinde sinistrâ manu leniter trahere umbilicum ita ne abrumpat, dextrâque eum sequi usque ad eas quas secundas vocant, quod velamentum infantis intus fuit; hisque ultimis apprehensis, venulas membranasque omnes eâdem ratione manu diducere a vulva, totumque illud extrahere, et si quid intus præterea concreti sanguinis remanet[1]."

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[1] Practical Directions, showing a method of preserving the Perineum in birth, and delivering the Placenta without violence. London, 1767.

We have given this quotation because some writers entertain doubts whether Celsus advised this practice in all cases, or only after the birth of a dead child, or protracted labour.

These opposite methods have been both extensively followed; and, though it appears that the practice recommended by Celsus was pretty generally adopted in the middle ages, yet several writers taught that the secundines were to be left to the unassisted power of nature. Paulus Ægineta, Morgagni, Van Swieten, Délius, Zanetti, and others, positively affirm that they may remain a considerable time without danger to the female. Ætius and Philumenus recommend the removal of the retained placenta by the hand; but if the os uteri has contracted so as to render this difficult, various relaxing means are advised. Manual efforts are only to be continued during the first or second day, as the placenta, if left, will come away in a putrid state. They recommend also the use of powerful emmenagogues. Paré, in the fifteenth century, was the first to point out the errors in both extremes; for, while he deprecates the practice of leaving the placenta, he enforces most strongly the necessity of extreme caution in our endeavours to remove it. Still hasty, incautious, and violent proceedings were much practised; the funis was frequently torn away; or traction being made on the placenta before the uterus had time to contract, this organ was so easily inverted, that Ruysch, who wrote very strongly in the sixteenth century in favour of the plan of leaving the placenta entirely to nature in all cases, states that he was sent for, twice in one day, to cases of inversion of the uterus. Manual assistance continued to be very generally practised in this country, and was taught in London by Chapman, Manningham, and Smellie. In the middle of the eighteenth century, however, Dr. William Hunter, observing the evils, and relying greatly on the powers of nature, determined to try the result of leaving the delivery of the placenta to those powers. This method was successful for some time; the secundines being regularly expelled without accident, generally in an hour or two, sometimes in twelve or twenty-four hours, and in some cases being retained for days without accident. But at length one of Dr. Hunter's private patients died soon after he left her room from a violent hæmorrhage; and in the practice of one of his pupils the placenta, after being retained thirteen days, was expelled a mass of putridity, and the patient died the same day. In another case a female died on the eleventh day, the placenta being still retained. Dr. Hunter, therefore, in his later years, adopted a modified practice, rendering assistance when the powers of nature were insufficient to complete her office, or any dangerous circumstances rendered it necessary.

The separation and expulsion of the placenta is greatly influenced by the conduct of the attendant in the last stage of labour. If after the birth of the head, the expulsion of the shoulder and body of the child be left entirely to nature, the uterus gradually contracts and separates the placenta, which is found in the vagina in ten, twenty, or thirty minutes after the birth of the child. But if the delivery of the child be accelerated by some officious person pulling the shoulder and body through the os externum immediately after the passage of the head, more or less retention will almost certainly follow. The uterus suddenly loses its stimulus to contract, and it remains flaccid, or irregularly constricted. So impressed was Denman with this opinion, that rapid expulsion of the child prevented the full contraction of the uterus on the placenta, and thereby became a cause of its retention, that he advises us rather to retard the final expulsion of the child, than to use any hurry or force in extracting it. But it appears that while he was thus warning us from one error, he was leading to another. The uterine contractions are, like all muscular efforts, fatigued by any exertion which is too violent or too long continued, and their remaining powers proportionably diminished. Now if, by artificially retarding the birth of the child, we excite the uterus to unnatural efforts, a protracted relaxation necessarily follows, which either leads to retention of the placenta, or, if this have been previously separated, to dangerous hæmorrhage. Again, we are recommended by Drs. Clarke and Collins, and the practice is understood to be generally followed in Dublin, never to allow the uterus to relax after the birth of the child, "pursuing, with a band on the abdomen, the fundus uteri in its contractions until the fœtus be entirely expelled, and afterwards continuing for some time this pressure to keep it, if possible, in a contracted state[1]."

The same objection applies to this as to the recommendation of Denman. The contractions of the uterus are unnaturally prolonged, and unnatural relaxation follows as a matter of course. The writer, impressed by the high character of Drs. Clarke and Collins, followed this practice in about twenty cases, but the patients complained a good deal of the pressure; and it is remarkable that the only severe cases of hæmorrhage, after the expulsion of the placenta, which have occurred in cases he has himself attended, were in those patients on whom he adopted this treatment. We cannot but think that it is this practice which leads the Dublin accoucheurs to lay so much stress on the application of the body bandage, and leads to the following advice of Dr. Collins:—"There is one point, with regard to which our practice should not on any account vary; which is, never to leave our patient for at least one hour after the placenta has come away[1]."

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[1] De Re Medica, lib. vii. cap. 29.

[1] Collins' Practical Treatise on Midwifery, p. 21.

On the grounds, then, first stated we neither follow nor recommend the Dublin practice, but adopt a course apparently more in accordance with the process of nature. Having allowed a little rest, in order to calm the general excitement of the patient, so common immediately after the birth of the child, tied the funis, and separated the infant, the hand is to be passed on to the abdomen to examine the state of the uterus, and determine the presence of another child. Supposing that the case is not one of twins, the condition of the uterus will vary according to the state of the placenta. Generally speaking, within five minutes after the birth of the child, if the labour has been a natural one, and the uterine contractions not unusually powerful, the uterus is found about the size of an adult head, soft, not very distinctly defined, and, on being grasped by the hand, it is felt to contract, becoming a harder, smaller, and more defined tumour. On examination the placenta is felt to be engaged in the os uteri; and we know that, in all probability, another contraction will propel the mass completely into the vagina. If the uterus be felt through the walls of the abdomen as a hard circumscribed tumour, about the size of the fœtal head, or if it be somewhat larger and softer, but gives a sort of yielding sensation under the fingers, like a well-developed female breast, we know that the placenta has passed entirely, or almost entirely, into the vagina. On examination the insertion of the funis can be felt, and the fingers passed around a large portion of the placenta. Again, the uterus may be felt as large as an adult head, hard, and perfectly defined, and the placenta out of reach, or so high that we can only feel a very small portion of it, and cannot detect the insertion of the funis; and in this case we know that the placenta is entirely in utero, and that the uterus has contracted upon it. Lastly, when, on pressing the abdomen, the uterus is found to be so lax, that its extent cannot be distinctly defined, and the placental mass and insertion of the cord are beyond reach, the uterus is known to be in a state of perfect relaxation, still containing the placenta. Under any of these conditions it is well, provided there be no signs either of external or internal hæmorrhage, to wait a moderate time to allow spontaneous contractions to arise, or spasm to abate. The patient should be made comfortable by dry napkins, and not disturbed by any meddlesome manœuvres, until either the lapse of time or some hæmorrhage indicate a necessity for interference. If a binder have not been applied during labour, a prepared bandage or a towel may be passed around the abdomen, or some slight pressure made by the hand on the abdomen, rather to afford a feeling of support than to cause pain. In the course of a few minutes the patient complains of a slight pain, the uterus is found to be smaller, and the placenta has descended; and if it be completely within the vagina, it may be immediately removed by a little traction of the cord in the direction of the axis of the outlet, or by seizing the mass with two fingers. It is well to turn it round two or three times, and withdraw very steadily, in order to bring away all the membranes, for, if any be left, they become enveloped in coagulated blood, and cause violent after-pains, considerably alarming the patient by their expulsion; and we know of a case where typhoid fever and decided maniacal symptoms obviously depended on the absorption of fluids which had been thus retained, and become putrid. We cannot be certain that the placenta is in the vagina merely because the insertion of the cord is within reach, as it is sometimes inserted quite to the lower edge of the mass; the only safe test is, being able to pass the finger around a large portion of the placenta itself. This is an important consideration, for, so long as any considerable portion of the mass remains in the uterus, we should not interfere, unless, as before stated, lapse of time or hæmorrhage render its removal necessary.

Having carefully examined the placenta to see that it has all come away, and felt that the uterus has duly contracted, a temporary abdominal bandage should be applied, and dry napkins placed under the patient, who should remain about an hour in the horizontal posture before being disturbed to have any of her dress changed, or the bed-furniture arranged. The nurse should be directed to apply, at the end of the hour, a bandage next the skin, reaching from the trochanters to the false ribs, in order to afford that support which the relaxed abdominal parietes cannot give, and become a useful auxiliary means in securing permanent uterine contraction.

We cannot agree with those who advise us to leave the expulsion of the placenta entirely to the natural efforts; for fully admitting that deliverance is a purely natural process, and that when the placenta had descended into the vagina the muscular fibres surrounding that canal, assisted by the abdominal muscles would be quite sufficient to complete it; yet the vagina having undergone severe extension and compression, in many cases a very considerable time would elapse before the return of its irritability. Indeed it would appear that in many of the cases in which the placenta is said to have been retained for several days without danger to the mother, it was simply lying in the vagina, from whence it might have been removed by the slightest traction of the cord. We withdraw it therefore, not only to free the patient from the mental anxiety which most females suffer till "all is over;" but to prevent the danger of internal hæmorrhage, which might arise from the placenta acting as a plug in the vagina; or the slighter evil of after-pains from retained coagula. This practice is not open to the charge of rashness, for traction on the cord should never be so forcible as to endanger its rupture. If there be resistance, the cause must be discovered and the obstacles removed. Force can never be necessary and must be injurious.

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[1] Op. cit. p. 125.

In twin cases the only modification in our practice is to tie the cord of the first child, in order to guard against the danger of loss of blood to the second, which would occur, if this were neglected, and if the vessels of the two portions of placenta anastomosed, which, however, very rarely occurs.

As the treatment of the placenta in abortion is treated in the article Abortion, and the subject of placenta presentations falls under the article Parturition, we have now to pass to the consideration of unnatural deliverance, or of those cases in which the assistance of art is necessary for its safe completion, either from lapse of time, hæmorrhage, convulsions, or any other cause.

UNNATURAL DELIVERANCE.

Very different opinions have been given by different authors as to the time we should allow to pass over after the birth of the child, before employing manual interference for the removal of the placenta. Dr. Blundell says, "wait half an hour, no particular symptom forbidding;" Dr. Merriman, one hour; Dr. Ramsbotham, one hour and a half; Drs. Denman and William Hunter four hours. The best rule of practice, however is derived partly from time, from the amount of uterine contraction, the situation of the placenta, and the presence of hæmorrhage. We feel convinced that half an hour is quite long enough to wait, unless the detention arises from an exhausted state of the patient, in which case if no dangerous symptom be present it is better to admit further delay in order to restore her energies, and allow the uterus to regain sufficient power to expel the placenta naturally. Supposing then that under any other circumstances this period has passed over, it is necessary to discover the cause of the retention. The most frequent are inertia, or atony of the uterus; its irregular or spasmodic contraction; and morbid adhesion between the opposed surfaces of the placenta and uterus. Besides these, Désormeaux, Dubois, Duges, Velpeau, and other French writers give excessive size of the placenta, weakness of the cord, and anteversion of the uterus.

It is very rarely that the placenta is of such a size as to lead to its retention, and though there are occasional exceptions, the enlargement is more apparent than real, depending upon the coagulation of a quantity of blood, either infiltrated into its substance, or effused upon and adhering to its maternal surface. Any difficulty from this source may be readily overcome either by bringing down the placenta edgeways, or by piercing its substance with the fingers, and removing any clots which may be present.

Rupture of the cord, as a cause of retention, is scarcely worth notice.

The falling of the uterus forwards, or to one side, may obstruct the removal of the placenta from the uterine cavity by means of traction on the cord, for if it be not drawn in a direction from the fundus to the os uteri, the placenta, though lying loose, is immovable. This however is remedied by passing the fingers of one hand deeply into the vagina to form a fulcrum for the cord, or by altering the position of the female.

We have now to consider retention of the placenta as consequent upon, 1, inertia, or atony of the uterus; 2, irregular contraction; and 3, morbid adhesion, either of which states may be simple or combined with each other; and may or may not be accompanied by hæmorrhage, according as the placenta is or is not separated.

I. *Retention of the placenta, from inertia or atony of the uterus*, occurs in weak delicate women of lax fibre, in those who have been exhausted by hæmorrhage before the birth of the child, or where the powers of the uterus have been completely worn out by the long continuance of labor, and in women who have borne a great many children. It is also frequent where the expulsion of the child has been too rapid, or the uterus has been so suddenly emptied by some officious practitioner that it is left without stimulus to contract, and remains in a torpid and relaxed condition.

The placenta being retained, we know inertia to be the cause, if the usual secondary pains be absent, if the uterus is larger and softer than natural, not contracting on pressure, the placenta out of reach of the finger, and the vessels of the cord are soft and flabby, instead of being turgid with blood, as they are when the placenta is compressed by the contracting uterus. Hæmorrhage may or may not be present. If so, it proves that more or less of the placenta has been separated, and in the generality of cases the amount of the hæmorrhage is a guide to the extent of the separation.

The treatment will depend upon the presence or absence of hæmorrhage. If there be no external flow of blood, and no faintness or other sign of internal effusion, and the patient be much exhausted, it is well to wait a short time to allow the system to rally, and the uterus to regain its contractility, merely employing slight friction on the hypogastric region, and making an occasional grasping pressure on the uterus; a dose of ergot should also be given. Traction of the cord is highly dangerous, as the cord, and some portion of the membranes may come away leaving the placenta; or the latter is separated, producing immediate hæmorrhage; or if it remain attached to the flabby uterine walls, they are drawn downwards with the placenta, and inversion of the uterus is thereby produced. The object is not so much to remove the placenta as to obtain a full and permanent contraction of the uterus, for in no other way can the safety of the patient be secured than by thus effecting closure of the vessels whose mouths have been opened by the separation of the placenta. In the majority of cases the friction recommended above, with a dose or two of ergot, and a little stimulation of the cervix uteri by the fingers will effect this. The latter means, I think, has scarcely attracted so much attention as it merits, for as irritation of the sphincters of the rectum and bladder, and of the orifices of the excretory ducts, stimulates these several organs to expulsatory action, so it would appear that irritation of the cervix uteri is calculated to excite contraction of the whole organ. Putting aside any analogy which may be drawn between the cervix uteri and the sphincters of the hollow organs, from the presence of a circular band of muscular fibres, we find that the cervix is more largely supplied with nerves than is any other part of the uterus, and in common with the sphincters of the rectum and bladder is supplied by the hypogastric nerve. Whether we strengthen our argument by the reflex doctrine or not, the practical fact is unquestionable, that gentle irritation of the cervix by the finger, is a very efficient means of inducing and maintaining uterine contraction.

When hæmorrhage is going on, we are not inclined to waste much time in cold abdominal effusion, or the injection of cold water or vinegar and water into the uterus, as recommended by many authorities, but at once proceed to remove the placenta by the introduction of the hand. The arm being bared and anointed, the hand is to be brought into the form of a cone, and guided by the cord, to be passed gently into the uterus. This if carefully done, causes very little pain to the patient, as the uterus itself and all the external parts are greatly relaxed. If the placenta be completely thrown off from its attachment, it is to be grasped by the hand, and by moving it about a little, the uterus will be stimulated to contraction, and the hand with the placenta expelled together. If the separation is only partial, the fingers must be passed between the uterine and placental surfaces, and when the mass is entirely separated, it may be removed as before. Great assistance is gained by steadying and grasping the uterine tumour with the disengaged hand placed upon the abdomen. It is very rarely that these means fail, and then only when the powers of the patient have been extremely depressed, but there are two cautions to be borne in mind whenever we endeavour to excite uterine contraction by friction and pressure on the hypogastric region. In the first place, if the uterus be in a state of flabby relaxation, direct pressure downwards made upon the fundus is especially calculated to produce inversion of the organ, and is proved to have done so in a case recorded by Dr. Doherty of the Dublin Lying-in-Hospital. Again, friction or pressure applied just above the pubis, supposing the patient to remain on her side, induces not the general contraction which we desire, but an irregular and spasmodic contraction which greatly increases the difficulty of the case. To avoid this, the relaxed uterus must be raised from the side to which it has fallen, or the female be placed on her back, when on grasping the fundus it is felt to contract, and then by directing gentle kneading pressure in the axis of the brim, the placenta will in the great majority of cases, readily pass into the vagina.

When called to a case where the hæmorrhage has been profuse, and all uterine contractility is lost, we must regulate our treatment according to the continuance of the hæmorrhage, for if it have ceased for a time, it would be absurd to open more bleeding vessels by completing the separation of the placenta, and empty the uterus, leaving it in a flabby relaxed condition. The first question therefore is, with regard to the propriety of stimulants, which must be freely exhibited when there is any immediate danger of sinking, remembering, however, that the depressed state of vascular action, of which syncope is the most alarming evidence, is a condition in which the blood very readily coagulates and fills up the orifices of the bleeding vessels. Unless, therefore, some alarming symptom be present, it would be dangerous to stimulate the circulating system to detach the clots, which, in the absence of uterine contraction, are the sole barriers between the patient and death. But if the surface of the body is clammy and cold, the face and lips blanched and ghastly, the pulse very rapid, intermitting, or imperceptible, the breath cold, or there is vomiting, sighing, jactitation, or amaurosis, hot brandy and water must be freely administered until the body becomes warmer, the pulse rises, and the lips become more florid. Any quantity, however large, may be given until these effects are attained. Manual interference must be regulated by the persistence of hæmorrhage. If it have ceased in a case of alarming collapse, we must trust to stimulants, ergot, and the application of cold, for if the clots be disturbed, a fresh gush of blood takes place, and the patient dies; but if the flooding continue either by gushes, clots, or draining, in addition to the means just mentioned, one hand should be passed into the uterus and stimulate its parietes, or, as Gooch recommends, compress the bleeding vessels with the knuckles, while the other hand grasps the uterine tumour from without. The aorta may be readily compressed, and some cases have been recently published in the French journals, proving that it is a means of considerable value in restraining the flooding for a time.

The placenta being removed, and uterine contraction induced, the patient must be most carefully watched, and pressure kept up on the abdomen at first by the hand, and afterwards by compress and bandage, as there is every reason to fear a new relaxation of the organ, with further flooding. The placenta must be carefully examined to see that it has all come away, for if any portion be left, though the uterus may contract powerfully, still, as it is prevented by its contents from thoroughly closing its cavity, hæmorrhage may go on. After perfect expulsion, also a trickling of blood may continue, from the presence of coagula, which operate in the same manner. The treatment in either case is simple. If any considerable portion of placenta remain, the hand must be introduced for its removal, but one or two fingers will generally suffice in case of coagula, as the irritation of the cervix, and motion of the clots excites the uterus to contract, empty itself and thereby prevent further effusion. In some cases we can only succeed in inducing temporary contraction, relaxation obstinately recurring, with fresh hæmorrhage and increased danger. Dr. Rigby states that nothing so certainly produces permanent contraction, under these circumstances, as the application of the child to the mother's breast, and as there can be no harm in the application, it should not be neglected.

In all these varieties of cases we must most carefully guard against the occurrence of internal hæmorrhage, by keeping up an effective pressure upon the uterus. The patient must also be kept a considerable time in the horizontal posture, to maintain the cerebral circulation, and obviate the tendency to syncope. After a time a dose of opium may be given to allay irritability, with stimulants, according to circumstances. The room must be darkened and well ventilated, the patient being kept for a short time on milk diet with a little wine, and afterwards allowed wine with jellies, and quinine with aromatics. The symptoms we may have to treat are cephalalgia, meteorism, tinnitus aurium, perspirations, faintings, œdema, and hectic. They all depend on the state of anæmia, and therefore can only be permanently removed by time, nutritious diet, and tonics, but they may be all palliated for a time by simple means. I have found the peculiar throbbing headach, so common in these cases, best relieved by the following lotion applied over the forehead several times daily. It rarely remains on more than ten minutes without affording marked relief: ℞. Sodii chloridi ʒiii; liquoris ammoniæ ℥i; spiritus camphoræ ʒii; aquæ fontis ℥ix; Solve, et misce. The meteorism is generally relieved by an enema of turpentine, or assafœtida; the perspirations and faintishness by ammonia effervescing with lemon-juice, with or without a small quantity of tincture of henbane. Quinine will generally be required, especially where there are febrile remissions, and a moderate dose of opium may be given at night. Where the œdema persists, after the disappearance of other symptoms, it will soon yield to small doses of digitalis, in combination with the muriated tincture of iron.

II. *Retention, from irregular contraction of the muscular fibres of the uterus* (*placenta chatonné, enchatonné, enkysté* of the French writers; *hernie de l'arrière-faix* of Solingen) is most frequently observed in labours which occur two or three weeks before the usual period; in women of great nervous excitability; in cases where the uterus has been very rapidly emptied, and the removal of the placenta has been early attempted by rude pulling at the funis. Under any of these circumstances the uterine contraction, instead of regularly progressing from the fundus downwards, takes place irregularly, some of the fibres remain relaxed, or less contracted than others. This condition was first noticed by Ambrose Paré and Guillemeau, afterwards by Mauriceau and most other writers on midwifery. Levret says that the parts of the uterus to which the placenta is attached, remain in a state of inertness, while all other parts of the organ contract with more or less force. Baudelocque supposed that the band of fibres forming the os uteri internum are more stretched during labor than any other part, and are therefore more disposed to contract. Leroux and Koch considered that the surface of the uterus is abraded in some points, the nervous fibrils exposed, and being more strongly irritated at these points than at others, excite irregular contraction.

When the fibres of the body of the uterus alone act, those of the fundus and cervix remaining uncontracted, we have what is called the hour-glass contraction, but this is much less frequently met with in practice than one would be led to suppose from the writings of some authors. The fact is, there is no part of the uterus where we may not meet with the constriction which divides the cavity of the uterus into two pouches. It is very rarely that there are more than two, but Velpeau says, that in one case he found three, and in another five. Under any of these conditions the placenta is wholly or partially behind the constricted portion, and is thus prevented from descending. When part is in the upper and part in the lower chamber, the mark of the constricted portion is very evident on the placenta after its expulsion.

The signs of this state are powerful after-pains, with turgidity of the vessels of the cord, while the placenta remains beyond the reach of the finger. The uterus is felt hard, and of some volume, through the abdomen, and may sometimes be felt clearly divided into two portions. If any separation of the placenta has taken place, there will be hæmorrhage, which is usually observed, though not often to great extent. On passing the hand into the uterus, the nature of the case is at once made evident by the presence of the constriction.

The difficulty of the case will vary with the intensity of the spasm, the amount of hæmorrhage, and the existence of morbid adhesion of the placenta to the uterus. If there be no hæmorrhage, four hours is not too long to desist from manual interference, keeping the patient perfectly quiet, and endeavouring to calm her feelings. An opiate enema, or a dose of laudanum may be given sufficiently large to allay irritability, but not so great as to lead to a danger of inertness of the uterus. Bleeding has been recommended, but should only be regarded as an exceptional practice, as we cannot foresee the amount of hæmorrhage which will take place from the uterus. Warm fomentations, or a large poultice of bran and hot water are often useful. Under this treatment the spasm will occasionally relax and the placenta readily come away. If not, the opiate may be repeated, the introduction of the hand being employed only as a last resource, on account of hæmorrhage, convulsions, or considerable lapse of time. The observation of Meckel is repeatedly borne out, that repose frequently suffices to complete what the hand of the accoucheur had in vain endeavoured to effect. Four hours, however, is perhaps the limit of delay, as there is a possibility that the uterus may undergo such a degree of contraction, as to prevent the introduction of the hand, and lead to the necessity of full opiates. When we have determined to remove the placenta, the hand is to be introduced as before till it arrives at the constriction, through which one finger is to be gently insinuated, then another, another, and lastly the whole hand. The placenta is then to be separated, when, in all probability, the uterus will contract strongly, and expel it with the hand. It is well to withdraw the hand very gradually, to ensure a general contraction of the uterus, and, if necessary, the broad part of the hand may be retained a short time at the point of principal contraction till the other portions act.

Where the neck of the uterus is the seat of spasm, and is contracted forcibly around the placenta, part of which is in the vagina, a little cautious dilatation of the os uteri will remove all difficulty.

III. *Retention from morbid adhesion between the placenta and uterus.*

This adhesion may be total or partial, slight or intimate; sometimes there is no great difficulty in separating the opposed surfaces, at others the tissues are so confounded together that it is impossible to distinguish them, or effect separation without abrasion of the uterus. Sometimes the adhesion is in one circumscribed spot, at others around the whole circumference, while in another class the borders are free, several points of the middle portion firmly adhering. The rarest case of all is where the adhesion is total.

The nature of these adhesions is by no means clearly understood; the older writers attributing them to scirrhosities of the uterus or placenta, while many more recent authors believe they are owing to the effusion of coagulable lymph from the lining membrane of the uterus under inflammatory action. There are objections to both assumptions, for the placenta is frequently found to have undergone more or less scirrhous degeneration, to be indurated or softened, and to contain calcareous or osseous granules, or scrofulous tubercles, where not the slightest morbid adhesion has existed. Velpeau also states that he has never heard of a case of morbid adhesion where the uterus was scirrhous, and that it is well known the placenta contracts a less intimate union with fibrous tumours upon which it has been developed, than with the uterus itself. Inflammation may probably be a cause in certain cases, as when, after some injury, a pain is felt in a part of the uterus corresponding to the spot at which the placenta is afterwards found attached. But sometimes such a pain is observed through a great portion of the term of pregnancy, where no adhesion follows, and it is very common to meet with adhesion where there have been no such symptoms. And, further, we know that inflammation of mucous membranes very rarely leads to the effusion of lymph and adhesion of their surfaces to each other, or to bodies with which they may be in contact. Careful anatomical observation is still required to settle this question.

The signs of this condition are continuance of uterine contraction, without descent of the placenta; and, on passing the hand into the uterus, we find that the retention is not owing to irregular contraction, but that the placenta is adherent and probably indurated. There is usually more or less hæmorrhage, as it is a rare case to meet with such total adhesion that no separation has taken place. The uterus, in most cases, is pretty firmly contracted, on account of the efforts it has made to expel the placenta; but it is sometimes in a state of inertia, and at others there is irregular contraction.

Two very different modes of practice have been recommended by accoucheurs, in the treatment of cases of morbid adhesion of the placenta; one class of practitioners leaving the patient to the unassisted efforts of nature, the other most earnestly enforcing immediate separation by the hand.

The principal arguments in favour of the former view are, that the placenta may remain an indefinite time without injury to the mother; and that the dangers of removing it are so great as to render the practice unjustifiable. Thus, Dr. Denman relates a case where a placenta was expelled evidently just separated, which had been retained fifteen days, yet there were very slight traces of putrefaction. The late Dr. Young, of Edinburgh, is said to have met with a case in which the placenta never came away, yet the woman recovered. Naegele also has brought forward cases to prove that the whole, or a considerable portion, of the placenta may be retained in the uterus, without any dangerous consequences to the mother; and Dr. Salomon, of Leyden, argues, from a case of his own, that where the uterus contracts so firmly as to exclude the access of air, putrefaction and all dangerous symptoms are obviated. Dr. Villeneuve, of Marseilles, has collected eight cases, including those of Naegele, in which it was found impossible to remove the whole of the placenta by the hand. In two the adhesion was complete, the placenta not being at all separated from the uterus; in none of the cases was any portion of the placenta expelled with the lochia. In the two where the adhesion was general, the hæmorrhage was very trifling, the lochial discharge scanty, and there was no constitutional disturbance. Dr. Rigby also relates a case where at least one third of the placenta was left behind, yet "there was no fœtor of the lochia, which throughout were sparing: it was also ascertained, beyond all doubt, that no solid substance had passed[1]." Cases of abortion have been occasionally observed, the fœtus coming away, the placenta and membranes being retained, no trace of them being afterwards observed; yet the catamenia have returned, and the patient borne other children without any peculiar circumstance. Désormeaux gives a case of this kind, where the placenta of an abortion came away with that of a subsequent conception a year afterwards. Then, as to the danger of attempts at removal, Smellie records two cases, in one of which he brought away the adherent placenta, but the woman died of hæmorrhage; in the second, he left the adhering portions, and the woman recovered. M. de Saint-Amand gives a case where death ensued from gangrenous inflammation of the uterus, following long-continued endeavours at separation. Rœderer also speaks of a woman who died of hæmorrhage, after forcible deliverance, where the internal surface of the uterus was broken up, and the fleshy fibres exposed to a great extent. Haller and Sandifort mention similar circumstances.

Some of these cases prove incontestibly that the placenta may be absorbed without evil consequences to the mother; but when it is argued from them that artificial separation of an adherent placenta is both dangerous and useless,—dangerous, because the uterus may be injured, and useless, because the adhering portions will be absorbed without augmenting the danger of the case,—they are forced to a construction they will by no means bear: for one of the cases cited by Dr. Villeneuve died with putrid discharge and typhoid symptoms; and four others suffered from considerable constitutional disturbance and uterine inflammation. In one of Naegele's cases, where about a third of the placenta was left, intense fever and violent cephalalgia followed; and, in a case of Salomon's, though the person ultimately recovered, there was low fever, abdominal pain, abundant perspirations, fetid lochia, vomiting, tympanitis, and emaciation. The danger of leaving retained placentæ in the uterus is strongly exemplified in the reports of Dr. Lee, published in the twenty-fourth volume of the Medical Gazette: for, of twenty cases, seven were fatal; and, in the other thirteen, more or less difficulty or danger ensued from portions or the entire mass of the placenta being left beyond the usual period. Burns relates a fatal case where the surface morbidly adherent was not larger than a shilling. There is a case in Rust's Magazine for 1831, which, while it tends to prove the possibility of absorption of the placenta, also shows the danger accruing to the mother during the process. The adhesion of the placenta was so perfect that it was found impossible to detach it, and it was therefore left. Severe fever followed by an eruption of pemphigas over the body, extreme weakness, frequent faintings, scarcely perceptible pulse, cold shiverings alternating with flushings, and great fœtor of the breath. The patient was in an almost comatose state, the lochia sparing and exceedingly loathsome. She remained in this state about a fortnight, and then began to recover. The catamenia re-appeared ten weeks after delivery; but neither in them nor in the lochia was there the slightest perceptible trace of placenta, and the uterus regained its normal size and form.

Madame Boivin is of opinion, that the first case of Naegele is open to suspicion, as the female was not attended by himself, and he was only informed of it by a midwife; and she further believes that his other cases, and that of Dr. Salomon, were merely instances similar to some she has herself recorded, of abnormal conformation of the placenta, in which the office of this mass is performed by mere vascular ramifications. But Salomon distinctly states, that, in his case, the placenta was felt in the uterus, and two small pieces were removed. If we admit, therefore, the presence of the placenta, absorption is the only supposition on which its removal can be accounted for: as the lochia have been sparing, the uterus has regained its original size; and the notion of rupture of the uterus and escape of the placenta into the abdominal cavity cannot be reconciled with the symptoms observed in any of the cases. Besides, absorption of the placenta is not without analogy in the animal kingdom: for Bartholinus[1] says, he has preserved in his museum a great part of the body of a calf, found in the uterus of a cow, in whom the signs of pregnancy had disappeared before the termination of the usual period of gestation, and many of the soft parts of the calf had been absorbed. Huzard[2] also quotes some very remarkable cases of this kind, where cows were killed, and their uteri contained only the bones of calves, all the soft parts having been absorbed. Carus says, he has seen a similar case of absorption of the soft parts of a fœtal sheep, preserved in the

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[1] Medical Gazette, vol. xiv. p. 333.

[1] De Insolitis Partûs Humani Viis, cap. v. p. 37.

[2] Mémoires de l'Institut National des Sciences et Arts, t. ii.

Museum of Natural History in the Veterinary School of Jena. Jager has recorded a case in Meckel's Archives, of absorption of parts of the fœtus in the uterus of a hind. The embryo was denuded of all the soft parts, and swimming in the liquor amnii.

Sufficient evidence has been adduced to prove, that the placenta may remain a considerable time in the uterus without injury to the female; but such cases are extremely few when compared with the very general opinions of practical writers, that she is exposed to the danger of hæmorrhage and the severe form of adynamic fever which has been observed to follow the injection of putrid substances into the veins. Indeed, if the placenta putrefy, we can scarcely expect any other result: for the putrid sanies, which is formed during the decomposition, cannot be supposed to remain in contact with the surface of the uterus without passing into the veins of the organ by imbibition or absorption. We have never met with any accoucheur of much experience who has not witnessed some of the evil effects arising from a prolonged retention of the placenta in the uterus, and therefore regard those cases brought forward in support of the opposite side of the question as exceptions to the general rule; and when it is argued that great injury is done in the endeavours at removal, we believe that this is owing to some want of skill or tenderness on the part of the accoucheur.

Our interference, then, is regulated by the time which has elapsed since the birth of the child and the amount of hæmorrhage, on the general principles before stated. Having determined to remove the placenta, the hand is to be introduced into the uterus, in the manner just described, in order to effect the separation. If it be partially detached, it is better to find the loosened edge, and cautiously pass the fingers backwards and forwards between this and the internal surface of the uterus, until the separation is complete. Dr. Hamilton advises us to grasp the placenta by its fœtal surface, and separate it by squeezing the circumference towards the centre; but this method is very liable to break off those portions least strongly adherent, and it is always better to commence the separation at one border; but, if this cannot be accomplished, the plan of Heister is preferable to the continuance of efforts likely to injure the uterus. He recommends us to pierce the placenta in its centre, and separate it from the uterus by the same finger. The nails must, under all circumstances, be closely pared, and every precaution taken not to scratch or tear the uterine membrane. The separation should be made as completely as possible; but the evidence adduced on the subject of placental absorption would induce us to follow the advice of Smellie, and rather leave a portion, than subject the mother to violence in order to effect its removal. It is fortunate, however, that this alternative will very rarely present itself in the practice of a skilful accoucheur. Where the uterus has contracted very firmly, it may be necessary to give a dose of opium before commencing our endeavours at extraction; and when our efforts cause much pain to the patient, it might be well to follow the advice of Dr. Collins,—to give small doses of calomel and ipecacuanha; and, if there be abdominal tenderness, to put her into a warm bath. Where the hæmorrhage has been very copious, and the patient is in a state of syncope, with a flaccid uterus, our practice must be guided by the rules given when speaking of a similar state under the head of retention from inertia. Should the pelvis be too small to admit the passage of the hand and placenta together, the hand must be first withdrawn, and the placenta brought down by means of the funis. The decidua is also occasionally adherent, but is said to be easily separated. If we have been compelled to leave some portion of placenta in the uterus, we must carefully guard against internal hæmorrhage, as Léroux states that the portion becoming subsequently detached has been fatal in this manner, by plugging up the os uteri. Other symptoms must be combated as they arise, taking care, however, to keep their cause in view, and not be led by seeming evidences of acute inflammatory action to employ active depletory measures for the removal of the effects of the admission of putrid matter into the blood: effects which both analogy and experience prove to be augmented by anything which depresses the vital powers. Mild laxatives should be given if necessary; but, if there be abundant diarrhœa, it must be checked by the opium or poppy injection. The vomiting is most readily relieved by very small doses of ipecacuanha, a quarter or an eighth of a grain, repeated as occasion may require. The diet should be simple and nutritious, with a little wine; and, as soon as the stomach will bear it, quinine may be given. Injections of a diluted solution of chloride of soda are of service in removing the fœtor of the discharges. Decoctions of cinchona and camomile-flowers are also highly spoken of as injections. If the symptoms do not abate, we are justified in making fresh attempts to remove the cause: for, in several of Dr. Lee's cases, by perseverance the os uteri was dilated enough to allow the passage of as much of the hand as was necessary to effect the removal. Experience is still wanting to decide in what cases the ergot would be admissible for this purpose; but there is a case recorded in the American Journal of Medical Science, for May, 1834, which augurs well for its efficacy. The case is that of a black girl, in whom the placenta was retained three days after delivery. Severe pain came on in the hypogastric region; the pulse was 120, and very small; the lochia disgustingly fœtid; and the os uteri firmly contracted and unyielding. Fifteen grains of ergot were given at intervals of half an hour; and immediately after the fifth dose, dilatation of the os uteri occurred, and the placenta was expelled.

Slight phlegmasia dolens followed, but the girl ultimately recovered.

For the management of the placenta in cases of convulsions, and repeated syncope after delivery, see Parturition.

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(*Thomas Spencer Wells.*)

DENTITION. See Teeth.

DENUDATION. This word, in its general acceptation, expresses the condition of a part stripped of its natural coverings, and may arise from wounds, abscess, gangrene, &c. A bone is said to be denuded when deprived of its periosteum.

DEPRESSION. The state of the bone in fractures of the cranium, in which one or more of the fragments is driven in upon the brain. The word is also used to describe the removal of the opaque lens from the axis of vision by means of the couching-needle in the operation for cataract.

DETRUNCATION. Syn. *Détroncation*, Fr.—The forcible separation of the body from the head of the fœtus, the head remaining within the organs of the mother.

Numerous instances of detruncation are scattered among the writings of practical obstetricians, the majority of which have occurred under the hands of ignorant persons, who have exercised violent traction upon the lower extremities of the child in breech or footling cases, or after the feet had been brought down by turning, without paying due attention to the axes of the pelvis, or directing their efforts in accordance with the varying dimensions of the pelvic apertures. The accident may happen, however, when the child has become softened by decomposition: and, in some rare cases, it is advisable to effect it by operative measures. Thus, in what was termed by Denman "spontaneous evolution," but which Dr. Douglas has more correctly described as the passage of the fœtus through the pelvis in a doubled state, much good may be gained by separating the trunk from the head. The acromion of the child revolves upon the symphisis pubis of the mother as on an axis; the head remains above the brim of the pelvis while the breech sweeps the sacrum and perineum, the head being expelled last. This process, however, cannot be completed without extreme distension of the perineum, and, in some cases, where the body has thus become wedged in the pelvis, detruncation is indicated. If the child presented with the neck immediately over the brim of the pelvis, it would be easy to pass a finger or blunt hook around the neck to serve as a guide for some cutting instrument. Dr. Ramsbotham described a sharp hook, which answers the purpose of separating the head very well; it is merely a large hook, the concave edge of which is sharp from the commencement of the curve to within a little distance of the point. It is passed around the neck, and the head is readily separated by using the instrument with a sawing motion, after which the body may be drawn out by the arm which protruded. This practice is far from new, for Ætius says, when the child presents double, that it is better to separate the trunk from the body, than to endeavour to push up the chest, and deliver by the feet.

The head being left in the uterus, whether from accident, carelessness, or design, the question arises as to the mode of removing it. Peu and Boër cite cases in which it has been rapidly expelled by the natural efforts alone; Asdrubali another, in which it remained several days: but these do not set aside the generally acknowledged necessity for artificial extraction. The hand must be introduced, the vertex brought downwards, and the head placed with its longest diameter in relation with the long diameter of the pelvic brim, when if the dimensions of the pelvis are normal, the uterine contractions will probably suffice to complete the expulsion. If not, the head must be steadied by external pressure, the vertex perforated, the brain removed, and delivery completed with the crotchet. See Crotchet. There will be but little difficulty in this, unless the pelvis be extremely deformed, in which case the osteotome of Dr. Davis would probably be the most ready means of speedily and satisfactorily terminating the case.

DIÆRESIS. See DIVISION.

DILATATION, from *dilatare*, to enlarge. In surgical language this term denotes the effect of *excentric* pressure,—that is, pressure exerted from the centre towards the circumference, as in the enlargement by various mechanical means of natural or artificial outlets or canals.

The surgeons of former times used to have recourse to dilatation under circumstances in which the moderns, preferring simple incisions, reject it altogether. Thus Marianus employed dilators in the operation for the stone, and Leblanc in that for strangulated hernia. Contusion and laceration of parts were of course the inevitable consequences.

The employment of dilatation is now limited to the temporary enlargement of apertures through which operations at a certain depth may be the more easily performed, as the mouth, vagina, and anus, by the speculum, or the fingers of an assistant; and to the slow and prolonged widening of natural openings, or canals that have been narrowed or obliterated, as the rectum, urethra, nasal ducts, nostrils, eustachian tube, and external meatus auditorius. Dilators for these purposes are tents or meshes of lint, prepared sponge, gentian or iris-root, bougies of metal, catgut or gum-elastic, various kinds of speculums, &c.

DILATOR. An instrument employed to effect the dilatation of natural or accidental apertures, or mucous canals.

DIPLOPIA (διπλοος, double, and ὤψ, vision; *visus duplicatus, double vision;* Fr. *diplopie;* Ger. *das Doppeltsehen.*) Under this head we have to distinguish double vision with the two eyes, and double vision with one eye, as these two kinds of diplopia differ very essentially from each other in their nature.

a. Double vision with two eyes.

As double vision with two eyes is merely a disturbance of the conditions, on which single vision with two eyes depends, an inquiry into those conditions forms a necessary preliminary to the consideration of our subject.

An affection of the retina is the primary condition of a visual perception, but a visual perception has in itself nothing to do with the optical apparatus regulating the transmission of the light which produces the affection. The question, therefore, why certain affections of the two retinæ should yield but a single, and others a double visual perception, is strictly physiological. All the purely physical explanations which have been offered of binocular vision have obviously reference alone to conditions not at all connected with the visual perception, but, from the nature of the optical apparatus in front of the retinæ, necessary, in order that the images of objects may be simultaneously projected on particular parts of those nervous expansions.

The particular parts of the two retinæ on which the rays of light from the same point of an object simultaneously fall, when the eyes have their natural corresponding direction, are the point of either membrane corresponding to the axis of the eyeball, and the various points or papillæ of the temporal half of one, and of the nasal half of the other, similarly situated in reference to it. These points or papillæ, called *corresponding, identical,* or *analogous*, have naturally, it is said, such a sympathy, that the simultaneous affection of them is followed by a single visual perception only; whilst double vision results from simultaneous impressions on any other parts of the two retinæ.

Objections have been urged against this doctrine of corresponding points of the retinæ. Mr. Wheatstone's ingenious observations[1] are quite decisive in exposing the exclusiveness of the doctrine as above stated, but that they do not overthrow it altogether, will I think be made to appear in the course of this article.

I beg to premise, that it is not my object to inquire *why* a single visual perception should result from the simultaneous affection of certain parts of the two retinæ—whether the thing be original, and dependant on the organization of the optic nervous apparatus, or whether it be a mere matter of experience, but simply to endeavour to analyze the phenomenon as it is observed in the adult.

The inference which Du Tour drew from his experiments[2] with a different colour presented to each eye, viz. that though we might occasionally see at the same time with both eyes, yet the mind cannot perceive simultaneously affections of corresponding points of the two retinæ, is, I believe, in some degree correct, but *all* the circumstances attending single vision with two eyes are not comprehended in it. Reducing to their essentials the phenomena observed in the experiments in question, it will be found:—that affections of corresponding papillæ of the two retinæ cannot be perceived by the mind at the same instant of time, but sometimes the one, sometimes the other. That this is the case can of course be ascertained only when the two impressions affecting the retinæ differ somewhat in colour, or otherwise, so as to be distinguishable from each other. It is to be remarked, however, that if the impression on the one retina be much the stronger, the resulting sensation decidedly predominates over, or even excludes from the mind's perception, that on the other. The appearance of the predominating image is nevertheless influenced by that which is not perceived.

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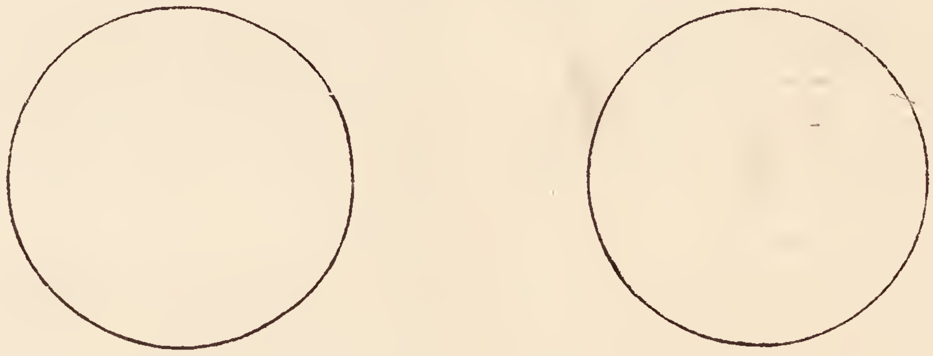
[1] *Contributions to the Physiology of Vision*, Part the First. *On some remarkable and hitherto unobserved phenomena of binocular vision*, Philosophical Transactions, Part ii. 1838.

[2] Du Tour's experiments consisted in looking at a white object through glasses of a different colour for each eye. The experiments may be conveniently repeated, by placing coloured discs in Mr. Wheatstone's stereoscope; or, in the absence of a stereoscope, by viewing two different coloured wafers in the manner immediately to be recommended for viewing the figures in this article.

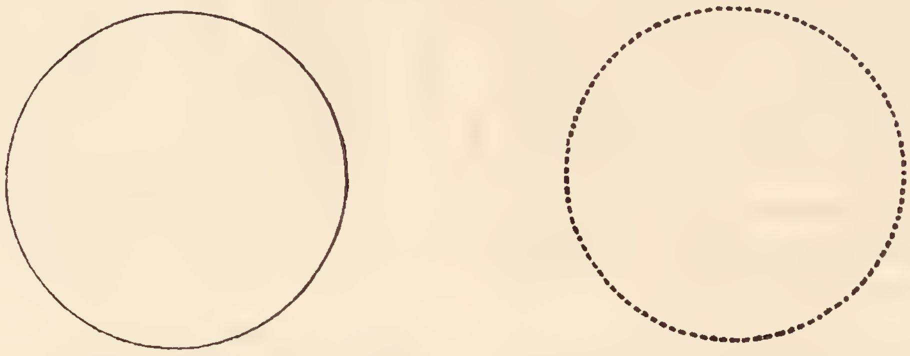
Present to each eye by means of Mr. Wheatstone's stereoscope one of two similar figures, or as a substitute for a stereoscope, hold a board (the board of an octavo book for instance) between the two eyes in front of the nose, and look at the circles in No. 1, in such a way, that the right hand circle is seen by the right eye only, and the left hand circle by the left eye. By the instinctive motion of the eyes, the two circles soon come to fall on identical or corresponding points of the two retinæ, and are then seen as one only.

Fig. 189. No. 1.



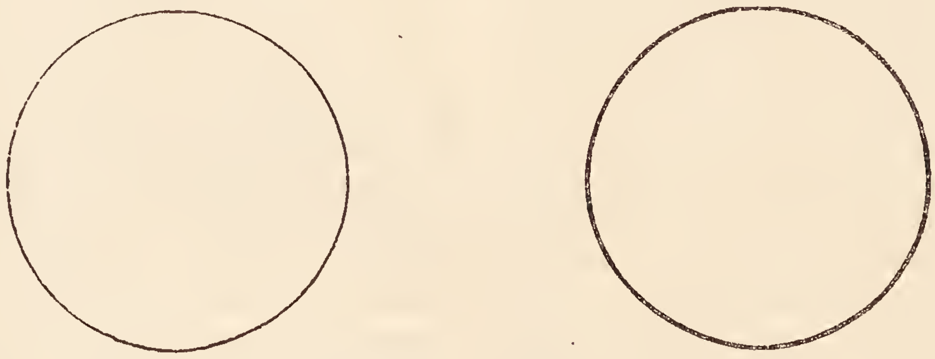
As the circles in the above experiment are similar, and produce equal impressions on the retinæ, no alternation of the resulting sensations is observable. But the impressions derived from the circles in No. 2, not being quite similar, it is easy to observe that sometimes the one, sometimes the other sensation is more particularly the object of perception at a given instant of time.

No. 2.



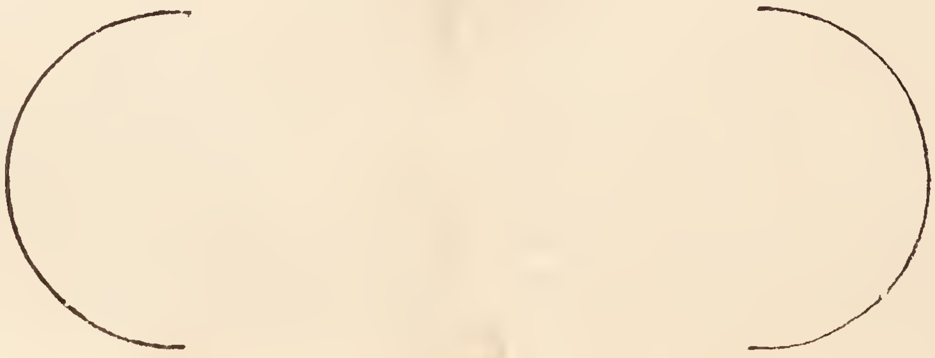
In No. 3, the line of the one circle is more strongly marked than that of the other. By looking at the two circles, in the manner above described, it will be found that the stronger excludes the weaker from being perceived.

No. 3.



If, then, of similar images on corresponding parts of the retinæ, one only, or part of the one and part of the other, are perceived at the same instant of time, we should expect a whole circle to be seen, by presenting one half of a circle to the one eye, and the other half to the other, in such a way that the respective images occupy each the place of the one retina, corresponding to that of the other, which would have been occupied by the image of the absent half of the other circle, if both had been complete.

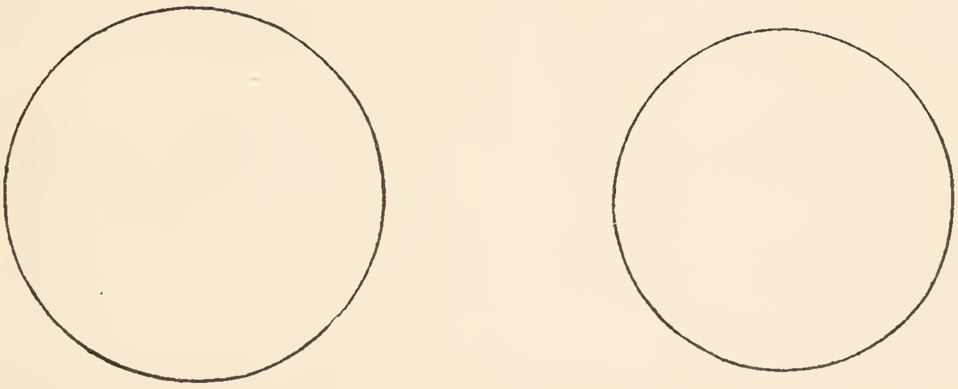
No. 4.



If we view the figures No. 4, in the manner already described, we shall find this to be the case. It is to be remarked, however, that we cannot so readily, as in the preceding examples, fix the complete circle, as, from the absence of a point on which to steady our eyes, they move either too little or too much; the effect of which is, that the images of the half circles either hesitate, as it were, to join, or having joined, are apt to pass each other.

Mr. Wheatstone has ascertained, that images differing in magnitude, within certain limits, but in other respects similar, if projected on parts of the two retinæ, as nearly correspondent as may be, coalesce, and occasion a single resultant perception.

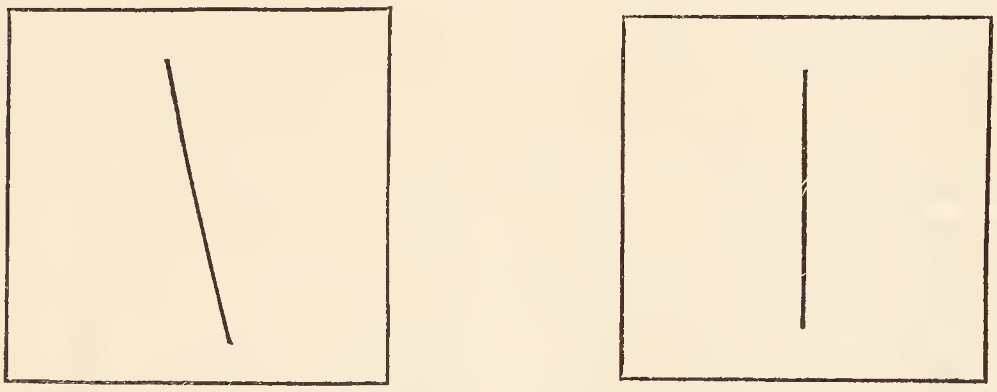
No. 5.



The circles in No. 5, dissimilar in size, if viewed by means of the substitute for a stereoscope already mentioned, will be seen to coalesce, and appear as one of an intermediate size, with the right and left edges at slightly different distances from the observer.

The mind, it has been shown, does not perceive affections of corresponding papillæ of the two retinæ at the same instant of time. It is found, by the above experiment, that the mind does not perceive, separately, affections of the two retinæ, resulting from impressions, which, although not on, are nevertheless near, corresponding papillæ. The one image is not in this case, however, seen to the exclusion of the other; but the mind fixes as if on a mean. For this to take place, it is to be always understood that, as Mr. Wheatstone points out, "the inequality of the pictures be not greater than the difference which exists between the two projections of the same object, when seen in the most oblique position of the eyes (*i. e.* both turned to the extreme right, or to the extreme left,) ordinarily employed;" and, it is to be added, that the one impression be not very much stronger than the other.

No. 6.

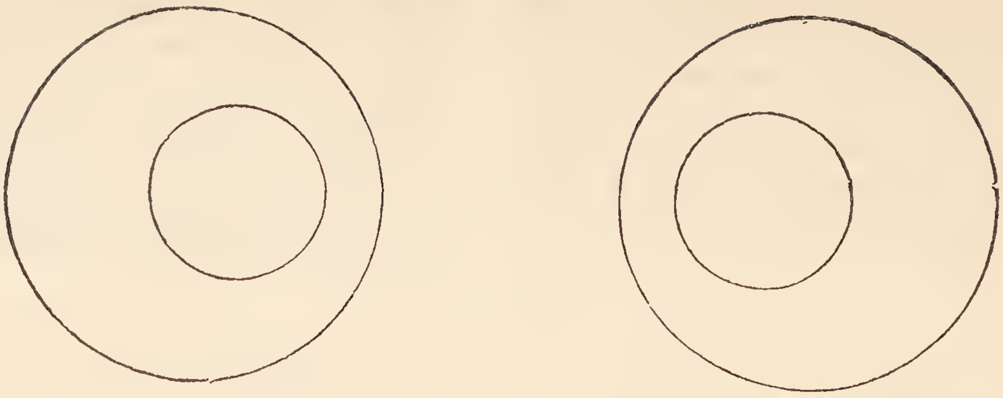


Another important point ascertained by Mr. Wheatstone, and connected in some degree with the preceding, is, that when we look at the figures, No. 6, in the stereoscope, or in the manner already indicated, the centre lines, though, if superposed, they would cross, coalesce, and a single line is perceived, one extremity of which appears towards, and the other from, the observer; in other words, the line appears as if standing out in relief. It is to be remarked, that the lines, in order to coalesce, should not, if superposed, have their extremities distant from each other beyond the limits above mentioned, in regard to retinal images simply dissimilar in size.

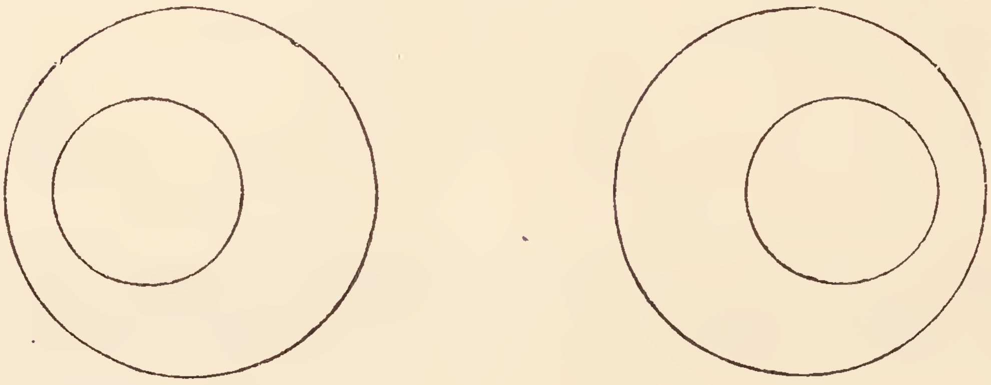
The fact demonstrated by Mr. Wheatstone, that, in viewing an object of three dimensions, while the optic axes converge, obviously dissimilar pictures are necessarily projected on the two retinæ, and yet the mind perceives but a single object not exactly like either of the pictures on the retinæ, is a most valuable contribution to the theory of vision; "It being thus established," says Mr. Wheatstone, p. 373, "that the mind perceives an object of three dimensions by means of two dissimilar pictures projected by it on the two retinæ, the following question occurs:—What would be the visual effect of simultaneously presenting to each eye, instead of the object itself, its projection on a plane surface as it appears to that eye?"

It was for this purpose Mr. Wheatstone invented the stereoscope. The effect is sufficiently produced by viewing the figures, Nos. 7 and 8, in the manner already recommended. The central lines of the figures No. 6, represent dissimilar perspectives, such as would be projected on the retinæ by a bit of wire held inclined with its extremities at different distances from the observer. The figures, No. 7, are the dissimilar perspectives of a truncated cone, and those of No. 8, the dissimilar perspectives of the interior of a hollow truncated cone.

No. 7.



No. 8.



"Were the theory of corresponding point true," Mr. Wheatstone remarks, p. 392, "the appearance should be that of the superposition of the two drawings, to which however it has not the slightest similitude." In answer to this, I would refer to what has been already said, from which it appears that there are compartments of the two retinæ, having certain limits, of which any one point or papilla of the one, corresponds with any one point of the other, so far that affections of them are not perceived separately. This, together with the fact that the more striking of two dissimilar retinal pictures, or the more striking parts of either retinal picture affecting corresponding parts, exclude from the mind's perception the less striking, and that even to some extent beyond their own outline,—is still, I conceive, applicable to the explanation of the phenomenon under consideration.

What appears to be a principal condition for the perception of relief, or of intaglio, in consequence of two dissimilar perspectives of the object impressed on parts of the retinæ within each other's influence, is the oscillation of infinite velocity of the mind between the two resulting affections, when a mean, as it were, results. Another is, when parts of one image are excluded by the predominance of parts of the other, an influence on what is seen by what is not seen.

In order that dissimilar perspectives of an object of three dimensions be received by the retinæ, the optic axes must converge; hence the part of the retina of either eye, on which the images are projected, is that where we find the foramen, yellow spot, and fold of Soemmerring.

This together with the fact, that besides in man, the central fold of the retina has been found among the mammifera in the quadrumana, the only other animals in which the optic axes converge, has led me to conjecture that we have in the central folds of the retinæ, a provision calculated to assist the coalition of very dissimilar perspectives on the two retinæ, and to render perfect our perception of relief or of intaglio, as presented by the object projecting the dissimilar perspectives.

Various considerations appear to me to favour this conjecture, but I refrain from entering further into the subject at present.

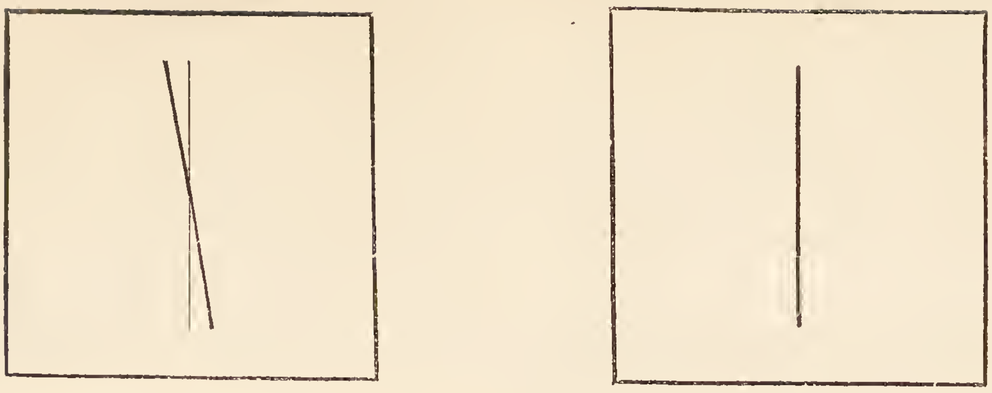
It is to be remarked that we do not see every object single: and why? for the reason that the more projecting an object is, the more dissimilar are its perspectives to the two eyes. Now, when the pictures on the two retinæ are very dissimilar, the parts which ought to coalesce, occupy places far beyond the limits at which papillæ of the two retinæ are influenced by each other; and therefore, an object, such as a needle for instance, looked at with one end directly towards us, is seen bifurcated or double.

Before concluding these preliminary remarks on single vision with two eyes, I think it necessary to allude to an experiment of Mr. Wheatstone, which he introduces with the following remark, p. 384:—

"I have given ample proof that objects whose pictures do not fall on corresponding points of the two retinæ may appear single. I will now adduce an experiment, which proves that similar pictures falling on corresponding points of the two retinæ, may appear double, and in different places."

The experiment is to look at the figures, No. 6, in the stereoscope, when the observer will perceive a line, the extremities of which appear at different distances before the eyes. Looking now at the figures, after the faint vertical line has been added to the left hand one, as in No. 9, "the two strong lines," says Mr. Wheatstone, "each seen by a different eye, will coincide, and the resultant perspective line will appear to occupy the same place as before; but the faint line which now falls on a line of the left retina, which corresponds with the

No. 9.



line of the right retina, on which one of the coinciding strong lines, *viz.* the vertical one, falls, appears in a different place. The place this faint line apparently occupies is the intersection of that plane of visual direction of the left eye in which it is situated, with the plane of visual direction of the right eye, which contains the strong vertical line."

"This experiment," continues Mr. Wheatstone, "affords another proof that there is no necessary physiological connexion between the corresponding points of the two retinæ—a doctrine which has been maintained by so many authors." So far from agreeing with Mr. Wheatstone, I am of opinion that the phenomena observed in this and similar experiments described by him will be found quite consistent with the theory of corresponding points of the retinæ, extended in the manner I have had occasion to suggest in this article. For instance, all that the experiment just described shows is, that, as the two strong lines fall upon parts of the two retinæ within each other's influence, the mind, as usual, does not perceive them separately. The resultant single line appears in a mean position and in relief. The strong vertical line of the right hand figure being thus drawn out of its position as it were by the attraction of the strong oblique line of the left hand figure, exerts no influence on the faint vertical line, which is seen unchanged, just as it falls on the left retina. The strong vertical line which falls on the right retina, if uninfluenced by the presence of the strong oblique line falling on the left retina, would predominate over and exclude the faint vertical line in the left eye. Nay, a careful contemplation shows that it does so in some degree, for after the faint vertical line is added, as in No. 9, the appearance of relief of the single line resulting from the coalition of the two strong ones, as seen in No. 6, is very much spoiled by the tendency of the strong vertical line to separate from the oblique line at one extremity, and cover or exclude the corresponding extremity of the faint line.

When from any cause there is a loss of the natural correspondence of the optic axes, the parts of the two retinæ on which the images of the same object are simultaneously projected are not corresponding parts; therefore, in accordance with what has been above said, the sensations arising from the two impressions are separately perceived by the mind, and the consequence is double vision. Double vision with two eyes is thus in itself not a disease, but, from the organization of the eyes, a natural result of derangement of those conditions on which single vision depends. The proximate cause of the derangement alluded to is most frequently irregular or impeded action of the muscles of the eyeball; but it may be an organic contraction of parts, some morbid production in the orbit, or the like, displacing the eyeball.

The two images in diplopia, are often distinguished into true and false—or real and imaginary; but such a distinction is improper, as the one image, although it may be less distinct, is not more false or imaginary than the other, both being equally the result of sensation produced by the impression of rays of light on the retinæ. That one of the two images is more distinct than the other, is owing to the circumstance that in one eye the impression is made on the central part of the retina, which is more sensible than any other; while in the other eye, the impression falls on a part of the retina, which according to the degree of deviation, is more or less distant from the centre. The adjustment of that eye, moreover, which receives the impression on the centre of its retina, corresponds more with the distance of the object looked at: the relative position of the two images depends upon the direction of the deviation of the eyes. As sometimes the deviation of the axes of the eyes exists only when the person looks in particular directions, and at certain distances, so does the double vision in such cases take place only when the patient looks in those directions, and at those distances.

The deviation of the optic axes giving rise to double vision may exist in various degrees, from an evident squint to a scarcely perceptible cast. It is in this latter case that the double vision is most marked, as the two retinal sensations are about equal in force, in consequence of the images of the object being projected on or near the centres of the retinæ, and on parts of it not far from being corresponding. When the deviation of the optic axes is still slighter, the two retinal images contend as it were to attract the mind's attention, and the object appears as if oscillating with velocity before the eyes, the consequence of which is confusion of perception when the two eyes are employed, and sometimes vertigo. As the person in this state can see things distinctly only when he closes one eye, the affection has been called *Monoblepsis*.

The name *diplopia* is usually confined to those cases in which the misdirection of the eye is so slight as scarcely to attract notice, but in which, for the reason above explained, the double vision is strongly experienced by the patient.

The irregular or impeded action of the muscles of the eyeball, giving rise to diplopia, may be owing to an affection of the muscles themselves or of their nerves, or it may be owing to disease or injury of the brain, or to drunkenness or fear, or to derangement of the *primæ viæ*, &c. But this is not the place to discuss the various primary affections on which the derangement of the muscles of the eye depends. It is enough to explain the nature of diplopia with two eyes, in order that, as a symptom in any particular disease, it may be appreciated at its due value.

b. Double or manifold vision with a single eye.

The preceding form of double vision depends, as we have seen, on a physiological cause; this form, on the contrary, depends on a purely physical cause—on irregular refraction, though it has not been precisely ascertained which of the refractive media of the eye is at fault.

"It is probable," says Dr. Mackenzie[1], "that irregular formations of the cornea, or of the crystalline lens, are much more common than is generally supposed, and that few eyes, in fact, are perfectly free from them. If they are very considerable, they may be detected by the observer's watching the progress of a candle in front of the patient's eye, and noticing the appearances of the three reflected images[2]. The patient may detect them by closing one eye, and directing the other to a very narrow well-defined luminous object, not too bright, (the horns of the moon, when a slender crescent, only two or three days old, are very proper for the purpose,) and turning the head in various directions. The line will be doubled, tripled, multiplied, or variously distorted; and careful observation of its appearance, under different circumstances, may lead the patient to a knowledge of the peculiar conformation of the refracting surfaces of the eye which causes those appearances, and may suggest the proper remedy.

M. Prévost, at the age of 81 years, published[3] an interesting account of his own case of double vision with a single eye, which he thought might arise from a fracture, bruise, or partial flattening of the lens, or separation of its laminæ. M. Prévost also communicated with Mr. Babbage, who is affected in either eye singly with double vision, a defect, however, which he finds himself able to remedy by looking through a small hole in a card, or through a concave lens."

In most presbyopic persons Dr. Arnott has ascertained double vision in either eye singly to exist in a slight degree, and he has discovered that it may be entirely obviated by having the glasses of the spectacles so placed, that the axes of the eyes may fall upon them more or less obliquely. Vision is at the same time rendered very much more distinct.

(*T. Wharton Jones.*)

DIRECTOR. *Itinerarium*, Lat. *sonde cannélée*, Fr. *Leitungsinstrument*, Ger. This instrument is a long thin grooved blade of silver or steel, and is in common use in surgical operations as a guide to our incisions, especially in deep-seated parts. In cutting down upon an artery, or a hernial sac, the intervening tissues are raised layer after layer upon the director, and thus securely divided with a bistoury. In laying open a sinus, as soon as the director is properly placed for the purpose, the parts are divided upon it at one stroke. Counter-openings for the exit of pus are made in the same manner.

DISLOCATION, from *dislocare*, to displace. In a limited sense, this term has been applied, and improperly so, to the displacement by violence of the articular surfaces of bones from their natural situations. See Luxation.

DISPLACEMENT. See Ectopia.

DISTICHIASIS, δις, *twice*; στιχος, *a row*. Literally, this word means a double row of eyelashes, but there is properly no real distinction between it and Trichiasis. See Entropium and Trichiasis.

DIVISION, διαιρεω, Gr.; *Durschschneidung*, Ger. The mechanical division of parts embraces a wide range of surgery, and is effected chiefly by means of sharp or blunt instruments, acting by section, laceration, ligation, or avulsion. Caustic substances are also employed in some instances to effect division, or solution of continuity. In its ordinary sense it means the reverse of re-union; but, in its most extensive acceptation, it includes *incision* by means of cutting instruments, sections by means of saws, scissors, &c., and *perforation* by means of the trephine, gouge, or chisel.

DRESSING. The mode of applying to injured or diseased parts such local means as are calculated to promote their reparation; preventing the access of air, or the contact of irritating substances; preserving the parts from great variations of temperature; exciting languid granulations, and repressing their exuberant growth. In the present day dressing is become reduced to very simple propositions, the digestive cerates, drying unguents, and varied plasters of the old school, having given place to the water dressing, for the revival of which the profession is indebted to Dr. Macartney, by which the warmth and moisture of a poultice, with all its soothing effects, are obtained without the weight, dirt, or offensive odour. It consists merely of a piece of thick lint steeped in tepid water and covered with a piece of oiled silk to prevent evaporation, the lint being changed once or twice a day. The various modes of dressing required in different cases, will be fully detailed in the articles Seton, Ulcer, Wound.

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[1] Practical Treatise on the Diseases of the Eye. 3d Ed. p. 795. London, 1841.

[2] See *Catoptrical examination of the Eye* in article Cataract, p. 713.

[3] Annales de Chimie et de Physique, Tome LI. p. 210; Paris, 1832.

DURA MATER. See Cancer, and Head.

DYSTOCIA, from δυς, *difficulty*, and τοκος, *parturition. Partus difficilis*, Lat. *accouchement laborieux*, Fr. See Parturition.

DYSURIA, from δυς, and οὐρον, *urine. Dysurie*, Fr. *Harnzwang*, Ger. In common language, Strangury. Painful, difficult, and scanty micturition may arise from such a variety of causes connected with the condition of the various parts of the urinary organs, that it can only be regarded as a symptom, which, taken by itself, is by no means sufficient to determine the nature of that condition or lesion. It was a common error with the elder surgeons to mistake a prominent symptom for a peculiar and distinct affection, and in this way very serious errors, both in teaching and practice, have been propagated. For the advancement of both, no doubt much benefit is being derived from that critical severity which, under the guidance of a more accurate pathology, is gradually restricting the employment of such vague terms. See Cystitis, Strictures of the Urethra, &c.

END OF VOL. I.

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